62746

Papillon Grand Canyon

ORIGINAL

September 3, 1999

U.S. Department of Transportation Dockets
Docket No. FAA 99-5927 - 37
400 Seventh Street SW, Room Plaza 401
Washington, DC 20590

Re: Comment to Docket No. FAA 99-5927, Notice 99-12, "Commercial Air Tour Limitation in the Grand Canyon National Park Special Flight Rules Area"

Dear Ladies and Gentlemen:

In response to the subject Notice of Proposed Rulemaking, I submit the following comments. In most cases I preface my comments with a reference to the section headings of the NPRM.

II. The Proposal
B. Comprehensive Noise Management Plan (page 15)

The "Purpose" of the NPRM states that the noise situation at Grand Canyon National Park (GCNP) has been analyzed over the past two years and that greater effort must be made to reach the statutory goals of Public Law 100-9 1.

There are no statutory goals of sound established in Public Law 100-9 1. Furthermore, **there has been substantive evidence presented to the Federal Aviation Administration (FAA) that the study presented by the National Park Service (NPS) over the past two years contains serious flaws in its analysis and presentation of the issue.** Please see the July 25, 1997 report, "Analysis of National Park Service Data on Air Tour Overflight Sound at Grand Canyon National Park" by John Alberti of JR Engineering, and the September 3, 1999 revisions to that report, included herein and by reference made part of this response.

The FAA and NPS have pledged their organizations to perform new studies, conduct new analysis of existing studies, have peer review evaluations, and reconsider the validity of studies based upon the FAA's modified INM computer modeling program and the NPS's NODDS computer modeling program. **Therefore, I strongly suggest that the FAA and NPS maintain a status quo position with regard to any changes in rules until such time as scientifically valid information and real presentation of impact is available.**

There is significant evidence demonstrating that the flights as presently configured fall well within the NPS's target goal that 50% of the park achieve "natural quiet" for 75-100% of the

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day. **Given that the goal has been achieved it would be punitive to impose further regulations.**

Although there has been discussion regarding incentives for the use of sound efficient aircraft, there has not been a sincere proposal to implement these quiet technology incentives. An incentive plan would give impetus to the operators to secure quiet aircraft. **The incentives should provide: special routing similar to the flight route that presently exists from the GCNP Airport; and allow operating hours from 7:00 a.m. to 7:00 p.m. with no limitation on the amount of flight during those daylight hours.**

Several companies have spent many millions of dollars on research, development and procurement of quiet aircraft technology with no opportunities of benefits to date. **A quiet aircraft incentive plan should be concurrent with any new regulations.**

<u>V. Regulatory Evaluation Summary</u>

<u>A. Benefits (economic evaluation) (pages 43 and 44)</u>

The economic evaluation and the cost benefits study are absolutely unsupportable. It is arbitrary by nature and unfounded by any measurable science. Furthermore, there are impacts not included in that study that must be included in order for the study to be valid. **Such impacts include but are not limited to: the loss to air tourists whose ability to fly will be diminished; impact to air tourists caused by increased fares; income loss to tour operators; loss of employment to air tour employees; as well as trickle down economic impacts to numerous related and unrelated businesses.**

I was unable to attend the August 19, 1999, hearing in Las Vegas. It is my understanding that at that hearing, the University of Nevada, Center for Business and Economic Research submitted a profound criticism of the economic evaluation. A copy of that report, “An Analysis of Proposed Flight Restrictions at the Grand Canyon National Park. Estimating the Costs, Benefits, and Industry Impact of the Proposed Regulation” prepared by Mary Riddel, Ph.D. and R. Keith Schwer, Ph.D. is enclosed and by reference is made part of this response.

It is grossly unfair and punitive to impose new regulations when there is such compelling evidence that the economic evaluation of the proposed rule will have such a profound effect on many small businesses. Furthermore the rights of millions of air tourist must be considered. Thousands of tourists each year choose to view the Canyon by air due to limited physical abilities, time constraints or other factors which limit their ground access to this marvelous natural wonder.

<u>II. The Proposal</u>

<u>D. Requirements Specific to Commercial SFRA Operations (pages 22 and 23)</u>

The current curfew hours in Dragon and Zuni Point Corridors are punitive and have caused significant loss to the operators located at G.C.N.P Airport. **I recommend that these hours be increased from 7:00 a.m. to 7:00 p.m. Such schedule would still provide 12 hours, or 50% of every day, totally flight free.**

<u>E. Operations Limitation (pages 23-33)</u>

May 1, 1997 through April 30, 1998, is not an appropriate year for establishing allocations.

If allocations do become regulation, there should be no restrictions with regard to what season they can be utilized. Park visitation dictates the number of flights that will be consumed in a given season, if allocations are on an annual basis flight usage will follow the historical past.

The concern that air tour operators may shut down during off-peak season to move off-season allocations into peak-season is not a valid argument. There would be no incentive to move off-season flights to peak-season. **This highly technical business requires continuity of personnel, extensive and recurrent training, off-season maintenance, etc. The locale of operation is home for the employees of these aviation businesses and they must sustain their families on a year-round basis.**

The existing; limitation on the number of aircraft is more equitable than a limit to the number of tours.

F. Flight Plans (page 34)

This information is already available from the "Overflight Fees" data. This provision would create an unnecessary additional burden to the FAA and operators, including costs to each, and possible delays in flights which would have significant adverse economic impact to operators. **Flight plans for scenic tour operators operating under the SFAR are completely unnecessary.**

H. Transfer and Termination of Allocations (pages 37-41)

Allocations must be considered a property interest; to not consider them as such would be tantamount to the unconstitutional seizure of property. Our company and others have spent millions of dollars in the development of employees, facilities, equipment, marketing, promotion, good will, etc., yet the business would be of little value if allocations were only an operating privilege. **Allocations if imposed must be an intangible asset belonging to each respective air tour company.**

The proposed rule provides that the FAA may withdraw allocations if a given operator has no activity for any consecutive 180 day period. In fairness to all operators but particularly the small operators, I believe the period allowed for inactivity should be lengthened. Small operators are most susceptible to slow downs caused by the seasonal nature of the business, equipment failures, serious illness of key employees or other adversities beyond the operators' control. A more equitable method of withdrawing allocations for inactivity would be as follows: **Subsequent to a 180 day inactive period, the FAA should secure a "Statement of Intent to Operate" from the tour operator. This statement would outline the operators' business plan for the following three year period. If upon the three year anniversary of that statement, the operator has not either resumed air tours, or sold the business, the FAA will proceed with reassigning its allocations on a prorata basis to the other active operators.**

I. Specific Matters for Comment (page 42)

1) The peak season of Grand Canyon is April 15 to October 15. The NPS however should not attempt to use a peak season period to assign allocations. See my response pages 2 and 3 under "E. Operations Limitation."

2) I have no opinion as to whether the time reported on the quarterly report should be Universal Coordinated Time or Mountain Standard Time. **I do not think this is a**

significant issue as long as the recorder makes note as to which measurement was used.

3) **Reporting should not be imposed as a condition of Form 7711.** Our company currently holds a full-time 7711 to fly into the Supai Reservation. Those operations are in support of a Native American Tribe and we would be less likely to provide this service if increased regulations made it less profitable. **The FAA currently grants 7711 under very tight restrictions and further control is unnecessary.**

4) Is 180 days an appropriate time to use or lose allocations? **Please see my comment on page 3 under the heading "H. Transfer and Termination of Allocations."**

5) Does the initial allocation reflect business of the date of this notice? **The initial allocation that has been developed for the 1997-1998 period does not reflect business operations as of the date of this notice.**

6) Should allocations remain unchanged for any specific amount of time? There should be no allocations until **reasonable** scientific evaluation of ambient sound levels have established what the ambient sound levels **are** at the sites in question in the Grand Canyon, computer noise modeling software validated and the NPS concedes that a day consists of 24 hours, by definition, etc. When and if allocations are instituted, there should be some future growth allowed as Park visitation increases. We should allow and establish criteria for increasing allotments as time and needs change.

V. Regulatory Evaluation Summary (page 43)

The proposed regulations do not meet the directive of Executive Order 12866 in that a Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs.

There are serious defects in the economic analysis that was used to demonstrate the impact of regulatory changes on the small businesses operating at the Grand Canyon.

The effect on international trade will be substantial and should be recognized by the Office of Management and Budget. Considerable numbers of foreign visitors use the aviation services in Nevada and Arizona. This fact is accurately presented under the heading "Foreign Trade Impacts of the Proposed Regulation" on page 19 of the University of Nevada study previously cited and by reference made part of this response.

The NPRM correctly recognizes that it would have a significant impact on a substantial number of small entities.

The assumption that the proposed rule would not constitute a barrier to international trade is incorrect. The proposed rule would adversely impact the balance of trade to the United States.

The document states that the NPRM would not contain any federal, intergovernmental, or private sector mandates. **I do not know if I fully understand this issue, however it certainly seems that this is a private sector mandate.**

A. Benefits

1. Restoration of Natural Quiet (pages 45 and 46)

The FAA and NPS estimate that natural quiet has been restored to only 32% of the Park and that air tour growth will in 9 to 10 years reduce that number to about 25%; this is deceptive manipulation of numbers and is purely arbitrary and speculative. **Natural quiet has already been achieved by SFAR 50-2 beyond the NPS standards. Furthermore, even the current conditions could be improved upon with quiet aircraft incentives to where 70 to 80% or more of the Park could have natural quiet 75 to 100% of the time. Please see the previously cited report by John Alberti, JR Engineering, by reference made part of this comment.**

2. Increased Value of Ground Visit Analysis **(page 46)**

See my comment on page 2 under the heading, "V. Regulatory Evaluation Summary, A. Benefits."

In summary, air tour operations in the Grand Canyon already meet the NPS goals and other than the relocation of the Dragon Corridor dog-leg there should be no further restrictions, changing of routes, curfews or allocations.

Very truly yours,

Elling Halvorson

Elling Halvorson
Chairman

EH/cb
Enclosures

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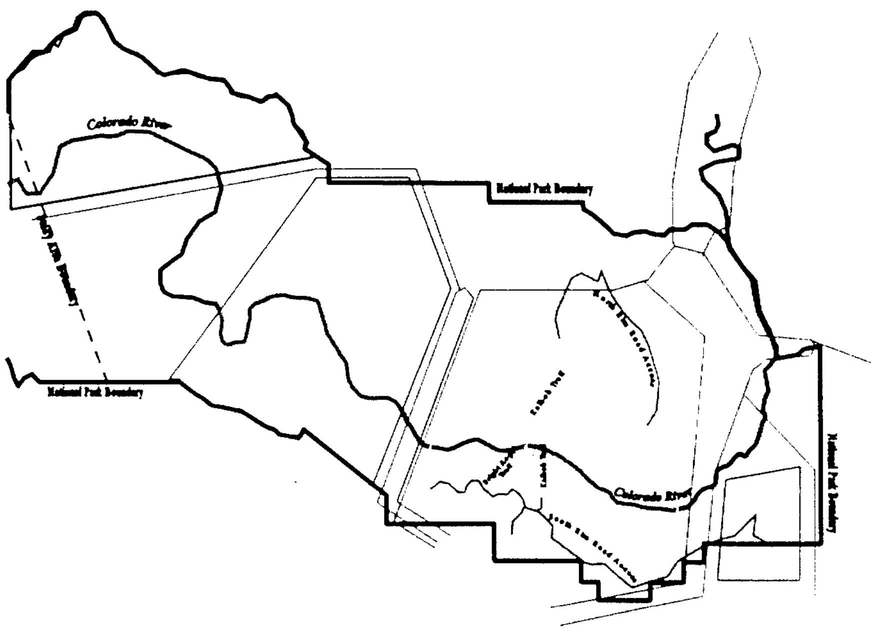
ANALYSIS REPORT

JRE DOCUMENT JR 182



ANALYSIS OF NATIONAL PARK SERVICE DATA ON AIR TOUR OVERFLIGHT SOUND AT GRAND CANYON NATIONAL PARK

Prepared for:

Helicopter Association International
On behalf of:
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LOG OF REVISIONS

Rev	Date	Affected Pages / Changes	Initial

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REFERENCES:

1. *"Draft Environmental Assessment -- Special Flight Rules in the Vicinity of Grand Canyon National Park"*, Jeff Griffith (ATA-1), FAA/BIA/NPS, 8/20/96

2. NPOA Report No. 93- 1, *"Evaluation of the Effectiveness of SFAR 50-2 in Restoring Natural Quiet to Grand Canyon National Park -- Final Report"*, S. Fidell, K. Pearsons, M. Sneddon, BBN Systems and Technologies, 6/23/94.

3. *"Draft Environmental Assessment – Noise Limitations for Aircraft Operations in the Vicinity of Grand Canyon National Park'*, Jeff Griffith (ATA- 1), FAA/NPS, 12/24/96

4. Noise-Con 96 Paper, *"'Barrier Diffraction and Sound Propagation in USDOT's New Traffic Noise Model"*, C.W. Menge, et al, Harris, Miller, Miller & Hanson, 6/96

1.0 INTRODUCTION

1.1 summary

New restrictions on flight operations have been imposed on tour aircraft in Grand Canyon National Park. The basis for this change is government studies claiming that aircraft noise would be audible in large areas of the park under existing rules.

Our analysis shows, however, that the government studies were biased and misleading due to several invalid and unscientific assumptions that overstate the sound levels and sound detectability. For example, their studies zero out the sound attenuating effects of trees, loose soil and other surface features. Their studies further assume a threshold of detectability that is lower than that shown by the government's own research.

When these errors are corrected, the result is that over 95% of the Park will meet the Park Services own definition of "natural quiet" in the busiest month for air tours (July).

We have evaluated this hypothesis from two different analytical perspectives:

Study A: The INM 5.0 study commissioned by the National Park Service (NPS) and performed by the Federal Aviation Administration (FAA), as reported in the Draft Environmental Assessment, Reference 1. This study was used by the NPS to justify more restrictive flight rules.

Study B: Our INM 5.1 study of operations in the Eastern end of the Park using actual 1996 aircraft operations as reported by the operators. This reflects what actually happened in 1996.

Even tested against the NPS's rather extreme and controversial definition of "substantial restoration of natural quiet," each of these analyses demonstrates that "natural quiet" has been restored under SFAR 50-2. These results are particularly compelling in the case of Study A since:

(a) This study, was conducted on behalf of NPS, using the NPS's and FAA's data, and;

(b) This study was not a neutral analysis and based on generally accepted practices in evaluating aircraft noise. Certain assumptions were made in the methodology of this study. These assumptions systematically bias the results in a manner that has the effect of obscuring the fact that "natural quiet" had been restored under SFAR 50-2.

1.2 Objective

The objective of this report is to explore and illuminate the assumptions underlying the government study of noise in Grand Canyon National Park and to provide a technically neutral evaluation of the "restoration of natural quiet" therein.

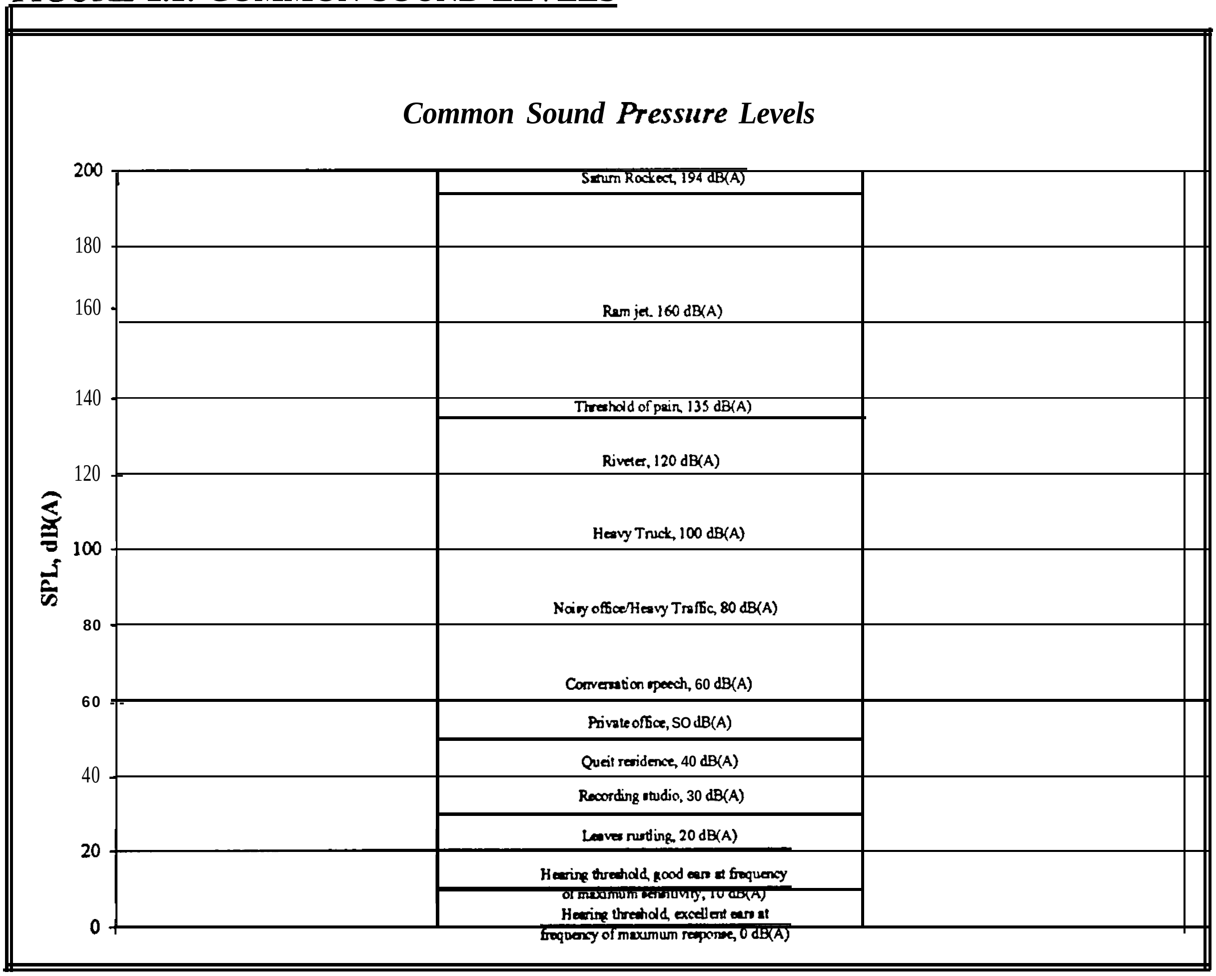
2.0 ANALYSIS

2.1 What Is "Natural Quiet?"

The National Park Service (NPS) in its 1994 Report to Congress, stated that "substantial restoration of natural quiet" will have occurred when at least 50% of the park is free of noticeable noise from sightseeing flights at least 75% of the time. (This definition has been challenged in court as too extreme, but our analysis shows that even this very demanding standard for "natural quiet" has been and is being met. It is being met, in fact, in far more than 50% of the Park.)

The Draft Environmental Assessment that accompanied the new Grand Canyon rules (Reference 3) indicates that the NPS has defined "noticeability" to mean a 3 dB(A) increase above the ambient sound level at any particular location. It has, further, assigned ambient noise levels in the neighborhood of 15 dB(A) to 17 dB(A) to most of the Park. These levels barely exceed the threshold of hearing (See Figure 2.1) and would be exceeded by rustling leaves, any hint of wind, or hikers' footsteps.

FIGURE 2.1: COMMON SOUND LEVELS



The BB&N study conducted in 1994 under NPS contract and reported in Reference 2 provides a more useful data set. This study found that 30 dB(A) is the average level at which observers sent into the Canyon first detected aircraft noise above the ambient level (onset), and were no longer able to detect the aircraft sound (offset). This is shown in Figure 2.2 (Figure E-4 from Reference 2)[1].

Reference 2 also correctly observes (Section 4.8) that noticeability of aircraft noise for someone not specifically engaged in listening for aircraft noise would occur at a 10 dB higher signal to noise ratio than for a vigilant observer. In our INM studies; we, conservatively, used the 30 dB(A) "observed" onset, offset level for vigilant observers.

FIGURE 2.2: MEAN SOUND LEVEL AT ONSET AND OFFSET OF DETECTABILITY
(Figure E-4 from Reference 2)

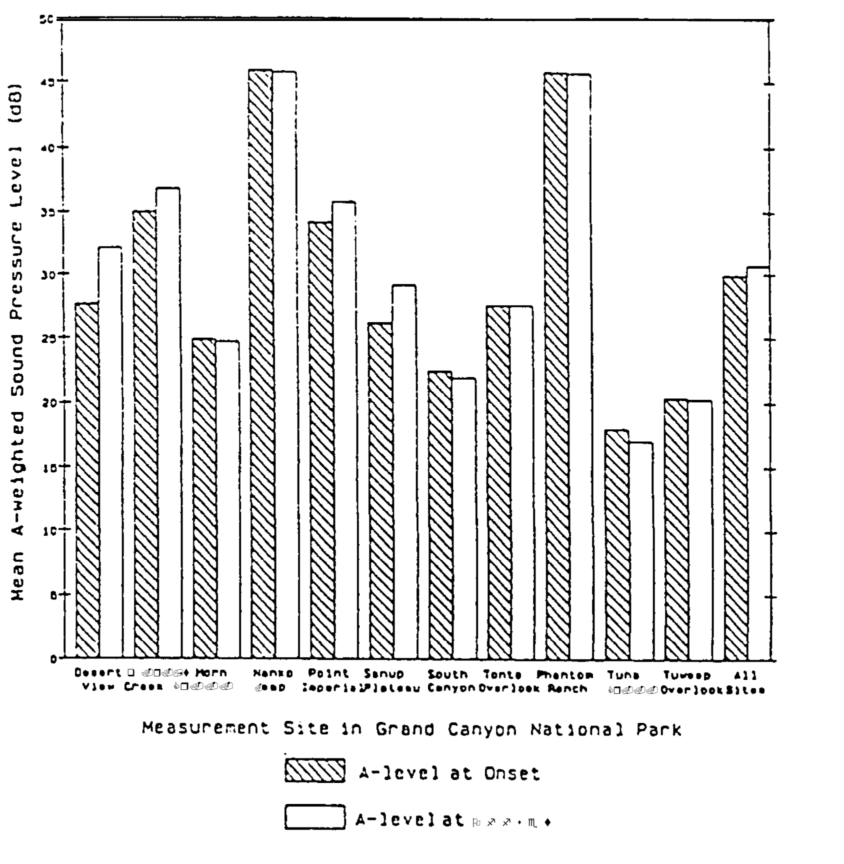


Figure E-4 Mean A-weighted sound pressure levels by site at onset and offset for air tour aircraft.

[1] Note that 30 dB(A) is the average level for onset and offset of detectability, individual sites having higher or lower levels. Since, the NPS criterion for "substantial restoration of natural quiet" requires that a "natural quiet" exist in 50% of the park, an average level is appropriate.

2.2 Noise Projections Using Integrated Noise Model (INM)

FAA developed the Integrated Noise Model (INM) for use in calculating community noise impacts in the vicinity of airports. This model is inherently conservative for application at the Grand Canyon because it does not filly account for the blocking effect of terrain between the source and observer. Version 5.1 is the most recent release of INM.

2.2.1 Study A: FAA INM 5.0 Study (Reference 1): Assumptions Leading to Overstatement of Noise Impact

The INM 5.0 noise analysis commissioned by the NPS incorporates a number of unusual and erroneous assumptions that consistently cause overstatement of noise impact. These biasing errors include:

2.2.1.1 Incorrect Helicopter Speed Correction

Reference 3, Table 4.1.2a, shows that the government **increased** helicopter sound levels taken from the Helicopter Noise Model (HNM)[2] by 1.1 to 1.5 dB. This ostensibly corrects the Sound Exposure Level (SEL) from test speed (116 – 128 kt) to Grand Canyon tour cruise speed (90 kt)[3].

The HNM, however, shows SEL **decreasing** as airspeed decreases to 90 kt[4]. The effect of this error is to overstate helicopter sound levels in the Grand Canyon.

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[2] HNM is an FAA developed program for computing sound from helicopters. FAA states that it plans to incorporate the HNM in the Integrated Noise Model (INM). The present INM Version 5.1 data base contains only fixed wing aircraft.

[3] This appears to be a correction for sound duration based on 10LOG(Vref/V). It ignores the more powerful effect of advancing tip mach number on helicopter sound. The reduction in advancing tip mach number at lower air speed causes the time integrated sound level, Sound Exposure Level (SEL), to decrease or remain the same, as airspeed decreases.

[4] We computed and averaged SEL directly under the flight path and 500 ft to either side, for a 500 ft flyover using HNM version 2.2. This produced the following:

- Aerospatial AS350D, SEL = 83.2 dB at 116 kt, 83.0 dB at 90 kt, a 0.2 dB reduction.
- Bell 206L, SEL = 82.2 dB at all speeds, no speed correction provided..

2.2.1.2 Elimination of Lateral Ground Sound Attenuation from the INM.

(This is sound absorption by ground and attenuation through disturbed air near the ground, not blocking by a barrier.)

The government **altered the code of INM Version** 5.0 to remove the computation of lateral over-ground attenuation[5]. This alters the program's basic computational method in a way that is inconsistent with all other sound studies conducted with this program, including those conducted under FAA regulation. The effect of this alteration is to overstate sound levels of all aircraft in the Grand Canyon.

The reason given for this alteration of the INM is that lateral over-ground attenuation *"is oriented toward acoustically soft, grassy terrain unlike that found at the Grand Canyon".* This assertion is difficult to reconcile with the following:

1) As noted in Reference 3, much of the terrain above 2000 meters (6560 A) is covered with conifer forest or other vegetation. These areas are very "soft", acoustically. Further, lateral over-ground attenuation occurs mainly in these higher elevation areas where sound propagation from an aircraft at 7500 to 9500 ft is more nearly horizontal compared with propagation to lower elevation points[6].

[5] The final EA, Reference 3, states (Section 4.1.2) that *"The INM is the FAA's standard computer methodology for assessing and predicting aircraft noise impacts. It's use in regulatory actions is governed by FAA Order 1050. ID, 'Policies and Procedures for Considering Environmental Impacts', under the National Environmental Policy Act (NEPA)."*

As provided to the acoustical engineering community by the FAA, INM version 5.0 (or the latest version, 5.1) does not have a user selectable input to turn lateral attenuation **OFF.** Thus, when used pursuant to Order 1050. 1D, lateral attenuation is always ON.

[6] The INM lateral over-ground attenuation model produces maximum attenuation for horizontal propagation, decreasing to zero as elevation angle increases to 60° or more.

- Thus, for an aircraft flying at 9000 A, MSL, the elevation angle from an observer on the canyon floor (3800 ft, MSL), 3000 ft to the side would be arcTAN((9000-3800)/3000) = 60° and the INM would have calculated zero lateral over-ground attenuation, altered or not.
- For an observer on the forested north rim at 8000 ft, MSL (and 3000 ft to the side), the elevation angle would be arcTAN((9000-8000)/3000) = 18.4° and the unaltered INM would (quite correctly) have calculated **a** 3.6 dB lateral over-ground attenuation. The FAA-altered INM would, thus, overstate the noise level by 3.6 dB, in this example.

2) Loose, dry dirt and gravel (in addition to grass, shrub and other vegetation) are common in areas of the canyon where people are likely to be (i.e. places other than sheer canyon walls). This terrain is nearly as "soft" acoustically as a grass lawn.'
3) In addition to the impedance match of earth and air, lateral over-ground attenuation is affected by disturbance of the atmosphere by the ground, including wind turbulence and temperature gradients.
4) If it is correct to alter the INM such that lateral over-ground attenuation is disabled whenever some acoustically "hard" terrain exists in the area of interest, then: this alteration should be required when the INM is used, under FAA oversight, to predict sound around urban and suburban airports where parking lots, freeways, buildings, bodies of water or other acoustically "hard" areas may be present. This alteration is, of course, never done (outside of the Grand Canyon) and cannot be done by an engineering user outside of FAA.
5) The EA (Reference 1) offers Appendix C (an 8/9/94 Memo from Gregg Fleming) to prove the validity of eliminating of lateral over-ground attenuation in this application. Appendix C compares measured levels in the Grand Canyon with predictions by the altered INM.
6) The data presented in Appendix C, however, shows that the INM predictions (without lateral ground attenuation) usually exceeded the corresponding measurements. Figure 2.3 (Figure 2 from Reference 1, Appendix C) shows this for DHC-6 Twin Otters. The text of Appendix C acknowledges the following over-predictions:

(a) A 3 dB average over-prediction in this case (DHC-6) at sites 1 and 2[8];
(b) A 2 dB average over-prediction for a mix of Cessna 182, 207 and 414A aircraft at sites 1 and 2[9];
(c) A 0.5 dB average over-prediction of a mix of Bell models 206 and 206L and Aerospatiale models 350 and 355 helicopters at sites 1 and 2.[10]
(d) A 1.7 dB average over prediction for 13 hourly L_{EQ} measurements and predictions at two sites *(3* and 15)
(e) A 9.9 dB average over-prediction for 9 hourly L_{EQ} measurements and predictions at Site 16.

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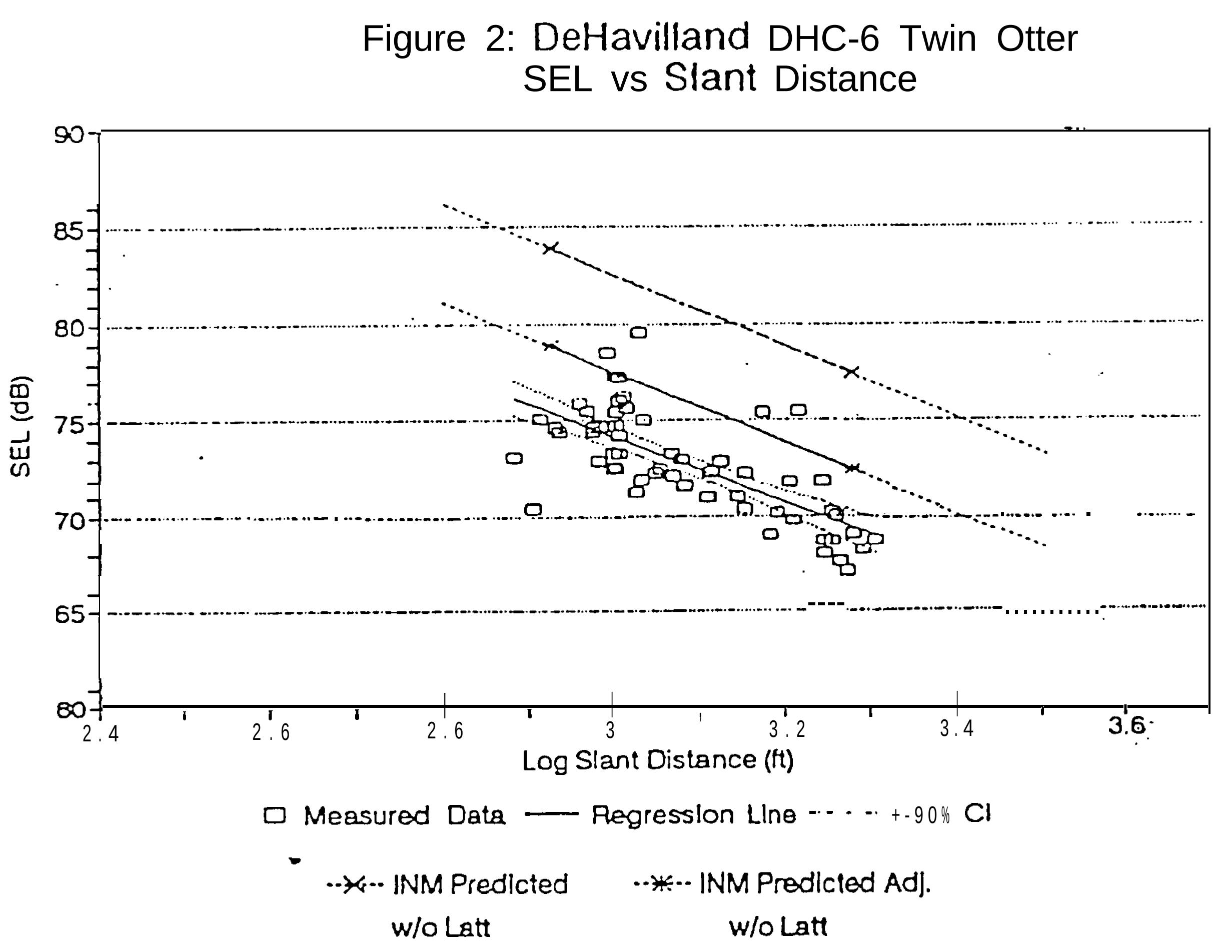
7 The US Department of Transportation's TNM (Traffic Noise Model), used to compute over-ground sound propagation around highways, assigns a 300 cgs Rayl effective impedance to lawn grass and 500 cgs Rayls to loose soil and gravel. For comparison granular snow is assigned 40 cgs Rayls (very soft) and pavement or water 20,000 cgs Rayls (very hard). From Reference 4.

8 Slant range varied from about 500 A to 2000 ft. Elevation angles were not given, but it is probable that many data points were at high elevation angles where the unaltered INM would have calculated little or no lateral over-ground attenuation. Thus the over-prediction could be greater at larger lateral distances.

9 Slant range varied from about 700 ft to 2500 ft. Comment from footnote 8 applies.

10 Slant range varied from about 300 ft to 3000 ft, with most of the data points between 300 ft and 1000 ft. Comment from footnote 8 applies.

FIGURE 2.3: COMPARISON OF MEASURED DHC-6 SOUND LEVEL WITH PREDICTION INM 5.0 WITH LATERAL OVER GROUND ATTENUATION DISABLED
(Figure 2 from Reference 1, Appendix C)



2.2.1.3 Assumption of 1 2-Hour Day

The NPS's INM 5.0 study assumes that a day is 12 hours long, rather than 24 hours long. This assumption increases LAEQ values 3 dB above their 24-hour day values. This also doubles the percent time above a threshold sound level (%TA) values compared with a 24 hour day.

24 - hour users of the Park such as, back country hikers and river corridor users are the most noise sensitive groups.

2.2.1.4 "Natural Quiet" Restored in Spite of Bias

Table 2.1 (Table 4.6 from Reference 1) shows that, even with the biasing effects of the above assumptions, the tour aircraft noise level was below 30 dB(A) 75% of the time in 2267 – 322 = 1945 square miles of the 2267 square mile study area. In other words, 86% **of the park was free of noticeable tour aircraft noise 75% of the time.** This more than meets the NPS definition of "substantial restoration of natural quiet."

TABLE 2.1: AREAS WITHIN 25% TIME ABOVE CONTOURS FROM GOVERNMENT INM 5.0 STUDY
(Table 4.6 from Reference 1)

Table 4.6

% Time Above Contour Areas

	1935 Base Case		1995 Alternative		% Change from Base Case
	%TA Contour Area (Sq. Mi.)	% of Analysis Area (2,267 Sq. Mi.)	%TA Contour Area (Sq. Mi.)	% of Analysis Area (2,267 Sq. Mi.)	
10	758.12	33.4%	901.77	39.8%	15.9%
20	549.04	24.2%	516.99	22.8%	-6.2%
25	465.55	20.5%	415.76	18.3%	-12.0%.
30	321.67	14.2%	282.59	12.5%	-13.8%
40	136.50	6.0%	149.76	6.6%	8.9%
50	80.03	3.5%	99.91	4.4%	19.9%
60	65.25	2.9%	57.53	2.5%	-13.4%
70	52.77	2.3%	42.82	1.9%	-23.2%

One would have to assume a threshold of noticeability below 10 dB(A) in absolute terms to find that "natural quiet" had been "substantially restored" to less than half of the park. Any reasonable understanding of the science of acoustics cannot support such a low threshold.

2.2 Study B: INM 5.1 Study of 1996 Tour Aircraft Operations Using Actual Operations Data

This study was conducted in the eastern end of the Park and encompassed the Fossil Canyon, Dragon, Zuni and Marble Canyon Corridors, an area of 1058 square miles bordered by a line running 2-5 miles east of Route Blue 1 to the east end of the Park. We did not evaluate noise from the Blue 1 route.

Tour operators provided aircraft operations data for the months of January through July. Appendix A provides contours of the time above the threshold of noticeability (30 dB(A)) for each month. Note that the largest time above contour is for 180 minutes (3 hours). The smaller, 360 minute (6 hours) contour is the significant one, representing 25% of 24 hours. Appendix A also details the underlying assumptions and sources of this information.

Table 2.2 shows that actual 1996 air tour operations in the Eastern end of the Park easily met the NPS definition of "substantial restoration of natural quiet." (At least 50% of the Park free of noticeable tour aircraft noise at least 75% of the time.)

TABLE 2.2: COMPUTED IMPACT OF TOUR AIRCRAFT ON "NATURAL QUIET" IN EASTERN GRAND CANYON NATIONAL PARK BASED ON 1996 OPERATIONS WITH 1996 AIRCRAFT

MONTH	Percent Area Above 30 dB(A)	Percent Area "Naturally Quiet"[11]
JANUARY	0%	100%
FEBRUARY	0%	100%
MARCH	0%	100%
APRIL	<0.1%	>99.9%
MAY	2.0%	98.0%
JUNE	3.1%	96.9%
JULY	4.6%	95.4%

Appendix B provides clear overlays showing these contours with respect to the park topographical contours and the areas where visitors actually spend time in the park. Overlaying the latter on the contours of Appendix A shows that, even in the busiest months, only that fraction of back country users (0.7% of visitor days) who choose to use the Dragon Corridor and River Corridor users (2.6% of visitor days), while crossing the Dragon Corridor would experience anything other than "natural quiet" as a result of air tour operations.

[11] Sound level from tour aircraft below 30 dB(A) at least 75% of day.

3.0 CONCLUSIONS

1. The government study shows that "substantial restoration of natural quiet" has occurred under SFAR 50-2 in spite of numerous invalid assumptions tending to bias the result in the opposite direction.

2. A technically neutral study shows that "substantial restoration of natural quiet" has occurred by an overwhelming margin under SFAR 50-2

APPENDIX A: Grand Canyon INM Noise Study

Studv Conditions

- Temperature 59° F
- Noise associated with airport activities is not included in test data
- 80% of flights are on flight track, 20% are ± .05 nmi off flight track

Summary of operations on *Average Daily Operations* for 1996 table

Flight Profiles

- Per diagram and Tables
- Speed is constant at 90 KCAS (approx. 101.5 KTAS)
- Altitudes per FAA SFAR 50-2 chart

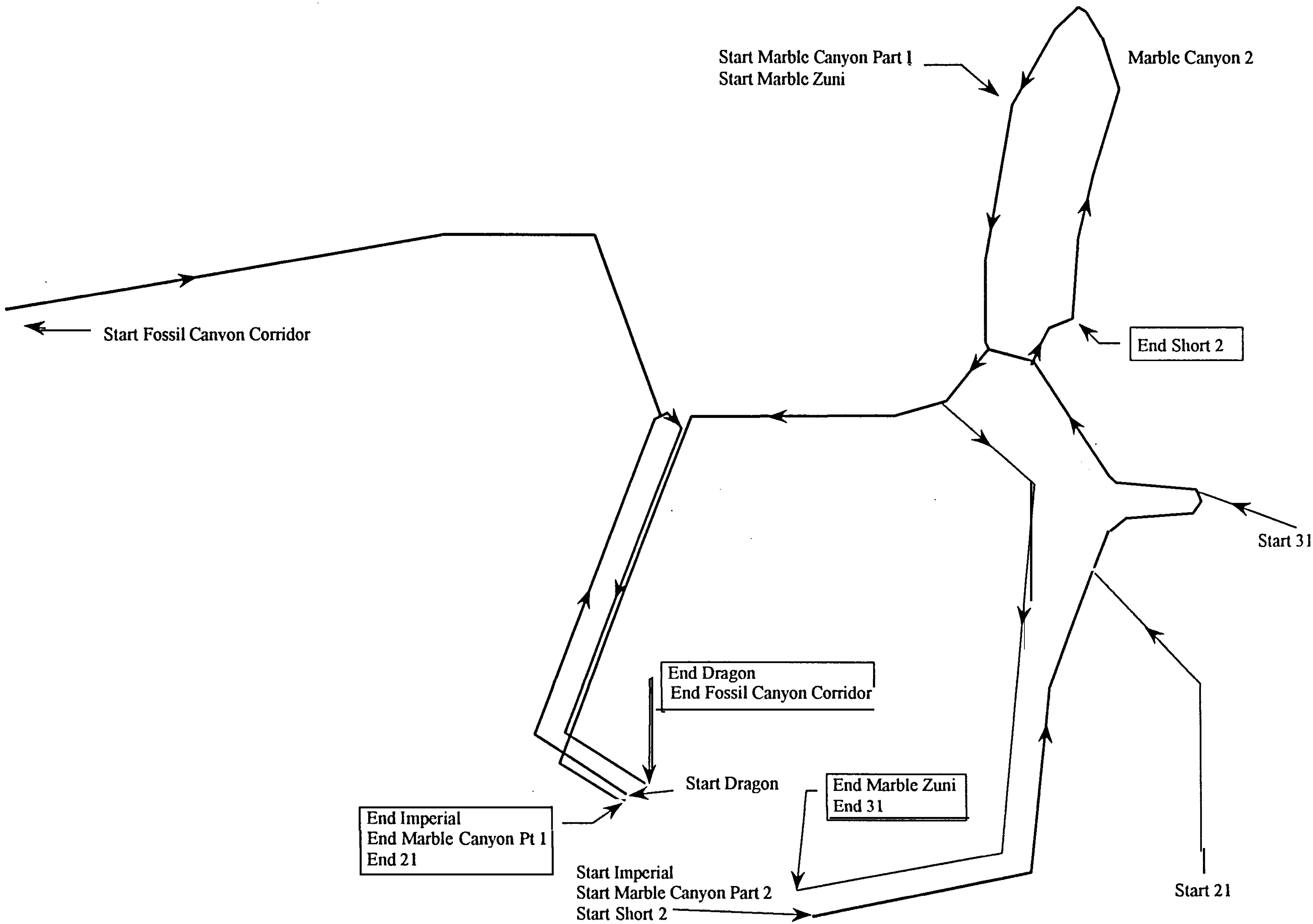
Aircraft Selection and Noise Data Base

A list of the aircraft in use as of 1996 was provided by the tour group operators. The helicopters are the Bell 206B, the Bell 206L-1, the Bell 206L-3, the Bell 206L-4, and the Aerospatiale SA350D. The airplanes were the Cessna 172, 172R, 177, 182, 182R, 207,208 and the DeHavilland DHC6Q.

Not all of the above aircraft are in the INM database so some aircraft data and noise profiles had to be created. The Cessnas were available as an approved substitute aircraft in INM. No changes were made to its database. The noise curves for the Bell 206B, 206L- 1, and 206L-3 were provided by John Daprile of the Volpe National Transportation Systems Center. The 206L-4 was incremented +.6 dB above the 206B.

The DHC6Q noise curves were based on the noise curves in the INM for the DHC6 and reduced 5.1 dB based on data provided by Raisbeck Engineering, the makers of the quiet propellers. Noise data for the SA350D was obtained from the HNM version 1 user's guide. (An average of left, right and center sound levels was used and the advancing tip mach correction was applied to correct to 90 KCAS).

For the NPD data used, see the following tables. Note that the noise identifier for the Cessna 172, 172R, 177, 208 and 210 is GASEPF. That for the Cessna 182, 182R is GASEPVP. That for the Cessna 207 is CT207A.


Start Marble Canyon Part 1
Start Marble Zuni
Marble Canyon 2
Start Fossil Canyon Corridor
End Short 2
Start 31
End Dragon
End Fossil Canyon Corridor
Start Dragon
End Marble Zuni
End 31
End Imperial
End Marble Canyon Pt 1
End 21
Start Imperial
Start Marble Canyon Part 2
Start Short 2
Start 21

Grand Canyon Noise Study with Current Aircraft

Average Daily Operations
Includes Operations by Scenic

GASEPF = sum of operations by Cessna 172,172R,177,208,210
GASEPV = sum of operations by Cessna 182,182R

Plane/	ROUTES				January					
Helicopter	Imperial	Dragon	FCC	Marble1	Marble2	Short M2	MarZuni	21.0	31.0	Totals
B206B,L	3.8	21.8	0.7	0.0	0.0	0.0	0.0	0.0	0.0	26.3
B206L-4	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
GASEPF	0.0	0.0	0.0	0.0	0.0	0.1	0.4	1.3	0.1	2.0
GASEPV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CT207A	6.0	0.0	0.0	0.0	0.0	0.2	0.8	0.4	0.1	7.5
DHC6Q	4.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.0	4.8
MDH600										0.0
S55QT										0.0
SA350B	0.5	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4
Totals	14.41	25.2	0.7)	0.0	0.0	0.3	1.71	2.1	0.21	44.6

Plane/	ROUTES				February					
Helicopter	Imperial	Dragon	FCC	Marble1	Marble2	Short M2	MarZuni	21.0	31.0	Totals
B206B,L	3.0	16.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0	20.4
B206L-4	0.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5
GASEPF	0.0	0.0	0.0	0.1	0.1	0.1	0.5	1.2	0.0	2.0
GASEPV	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1
CT207A	6.6	0.0	0.0	0.0	0.0	0.2	0.5	0.3	0.1	7.7
DHC6Q	4.4	0.0	0.0	0.0	0.0	0.0	0.6	0.3	0.0	5.4
MDH600										0.0
S55OT										0.0
SA350B	0.5	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4
Totals	15.0	22.81	0.5	0.1	0.1	0.3	1.71	1.8	0.2	42.5

Plane/	ROUTES				March					
Helicopter	Imperial	Dragon	FCC	Marble1	Marble2	Short M2	MarZuni	21.01	31.0	Totals
B206B,L	7.6	43.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	51.7
B206L-4	1.7	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5
GASEPF	0.0	0.0	0.0	0.1	0.1	0.1	0.7	1.6	0.2	2.7
GASEPV	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.2
CT207A	17.4	0.0	0.0	0.0	0.0	0.2	1.2	0.6	0.2	19.7
DHC6Q	7.4	0.0	0.0	0.0	0.0	0.2	1.1	0.5	0.1	9.3
MDH600										0.0
S55QT	2.1									0.0
SA350B	36.2	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.3 14.2
Totals		65.91	1.11	0.1						

Plane/	ROUTES				April					
Helicopter	Imperial	Dragon	FCC	Marble1	Marble2	Short M2	MarZuni	21.0	31.0	Totals
B206B,L	12.6	71.2	1.6	0.0	0.0	0.0	0.0	0.0	0.0	85.4
B206L-4	2.4	13.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.8
GASEPF	0.0	0.0	0.0	0.3	0.3	0.4	0.9	1.6	0.3	3.8
GASEPV	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2
CT207A	20.2	0.0	0.0	0.0	0.0	0.5	1.1	0.9	0.4	23.1
DHC6Q	11.1	0.0	0.0	0.0	0.0	0.3	1.5	0.2	0.2	13.2
MDH600										0.0
S55QT										0.0
SA350B	2.1	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.2
Totals	48.4	96.7	1.6	0.4	0.4	1.2	3.6	2.7	0.8	155.7

Grand Canyon Noise Study with Current Aircraft

Plane/	Moy									
Helicopter	Imperial	Dragon	FCC	Marble1	Marble2	Short M2	MarZuni	21.0	31.0	Totals
B206B,L	17.4	99.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	118.9
B206L-4	1.9	10.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.8
GASEPF	D.0	0.0	0.0	0.4	0.4	1.2	1.6	1.1	1.4	6.1
GASEPV	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.2	1.1
CT207A	25.0	0.0	0.0	0.4	0.4	0.7	1.0	0.8	1.2	29.5
DHC6Q	9.4	0.0	0.0	0.3	0.3	Oh	1.9	0.0	0.6	13.0
MDH600										0.0
S55QT										0.0
SA350B	2.1	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.2
Totals	55.8	122.0	2.51	1.3	1.3	2.61	4.7	2.01	3.4)	195.5

Plane/	June									
Helicopter	Imperial	Dragon	FCC	Marble1	Marble2	Short M2	MarZuni	21.0	31.0	Totals
B206B,L	18.1	102.8	2.8	0.0	0.0	0.0	0.0	0.0	0.0	123.7
B206L-4	1.8	10.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.2
GASEPF	0.0	0.0	0.0	0.6	0.6	0.8	0.9	0.5	1.5	4.9
GASEPV	0.0	0.0	0.0	0.2	0.2	0.1	0.2	0.0	0.0	0.8
CT207A	26.8	0.0	0.0	0.1	0.1	0.6	0.7	0.5	1.6	30.5
DHC6Q	14.9	0.0	0.0	0.0	0.0	0.9	2.1	0.0	0.5	18.5
MDH600										0.0
S55QT										0.0
SA350B	3.6	20.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.8
Totals	65.2)	133.4	2.8	1.0	1.0	2.41	3.81	1.0	3.61	214.3

Plane/	July									
Helicopter	Imperial	Dragon	FCC	Marble1	Marble2	Short M2	MarZuni	21.0	31.0	Totals
B206B,L	19.7	111.31	3.0)	0.0	0.0	0.0	0.0	0.0	0.0	134.0
B206L-4	1.71	9.81	0.0	0.01	0.0	0.0	0.0	0.0	0.0	11.5
GASEPF	0.0	0.0	0.0	0.5	0.5	0.9	1.1	0.41	2.0	5.5
GASEPV	0.0	0.0	0.0	0.2	0.2	0.1	0.2	0.4	0.2	1.3
CT207A	33.1	0.0	0.0	0.3	0.3	0.7	0.5	0.4	1.8	37.2
DHC6Q	26.5	0.0	0.0	0.0	0.0	0.9	2.0	0.0	0.7	30.0
MDH600										0.0
S55QT										0.0
SA350B	3.6	20.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.8
Totals	84.6	141.3	3.0	1.1	1.1	2.6	3.7	1.2	4.7	243.3

Only the above routes flown by Papillon,GCA,AGC,Scenic,Airstar, and Kenai are included in study.
All other flights are exlcuded
Flights for Native Americans are not included.

See attached map for flight path starting and ending points.

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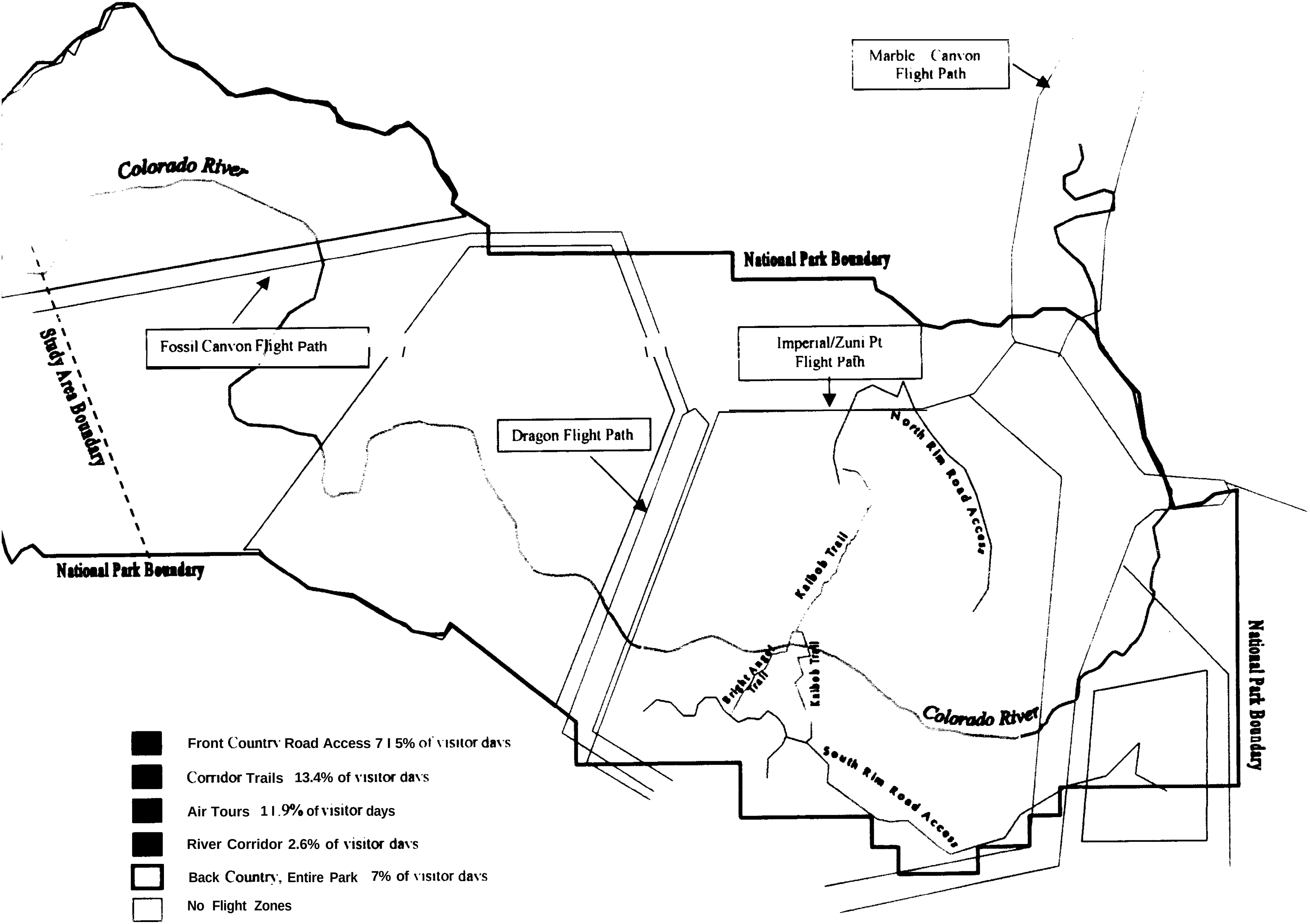
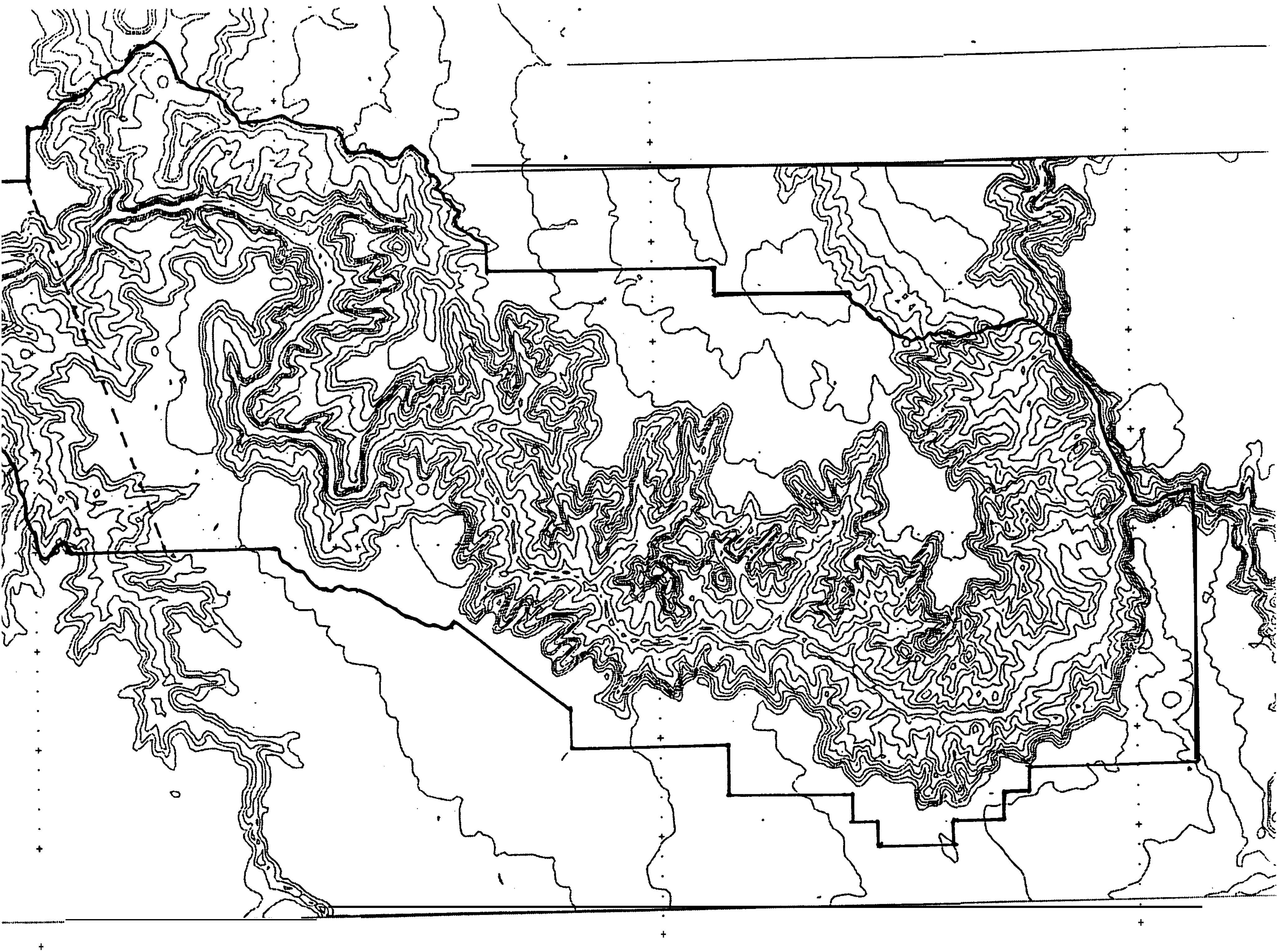
APPENDIX B:

OVERLAYS FOR SOUND LEVEL CONTOURS

1. Grand Canyon Topographical Contours
2. Areas Used by Park Visitors

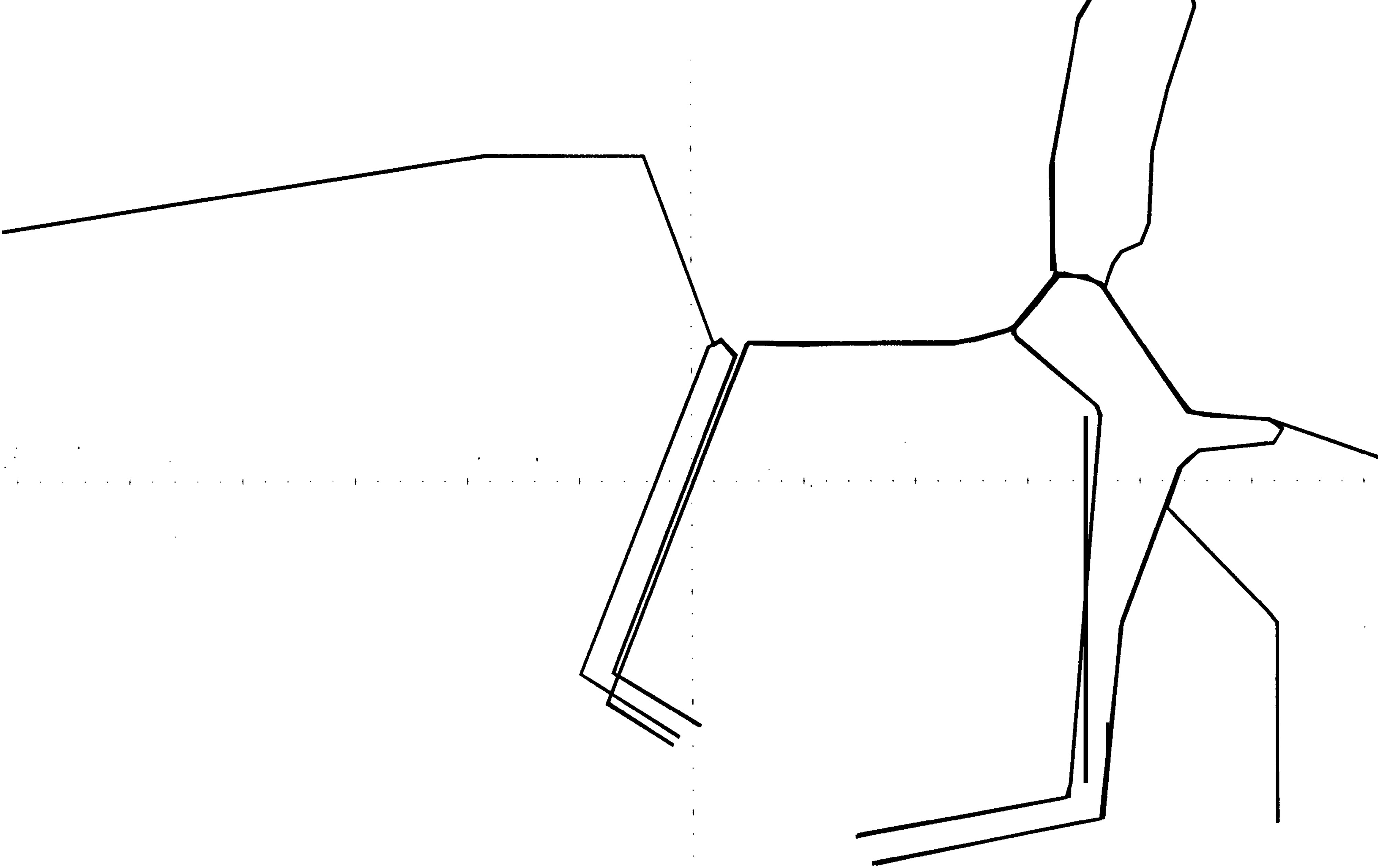

Marble Canyon
Flight Path
Colorado River
National Park Boundary
Fossil Canyon Flight Path
Imperial/Zuni Pt
Flight Path
Study Area Boundary
Dragon Flight Path
North Rim Road Access
Kaibab Trail
National Park Boundary
Bright Angel Trail
Kaibab Trail
Colorado River
National Park Boundary
South Rim Road Access
Front Country Road Access 71.5% of visitor days
Corridor Trails 13.4% of visitor days
Air Tours 11.9% of visitor days
River Corridor 2.6% of visitor days
Back Country, Entire Park 7% of visitor days
No Flight Zones



Park Area Above 30 dB for 3+ hrs

January

Date: 06/12/97 12:27

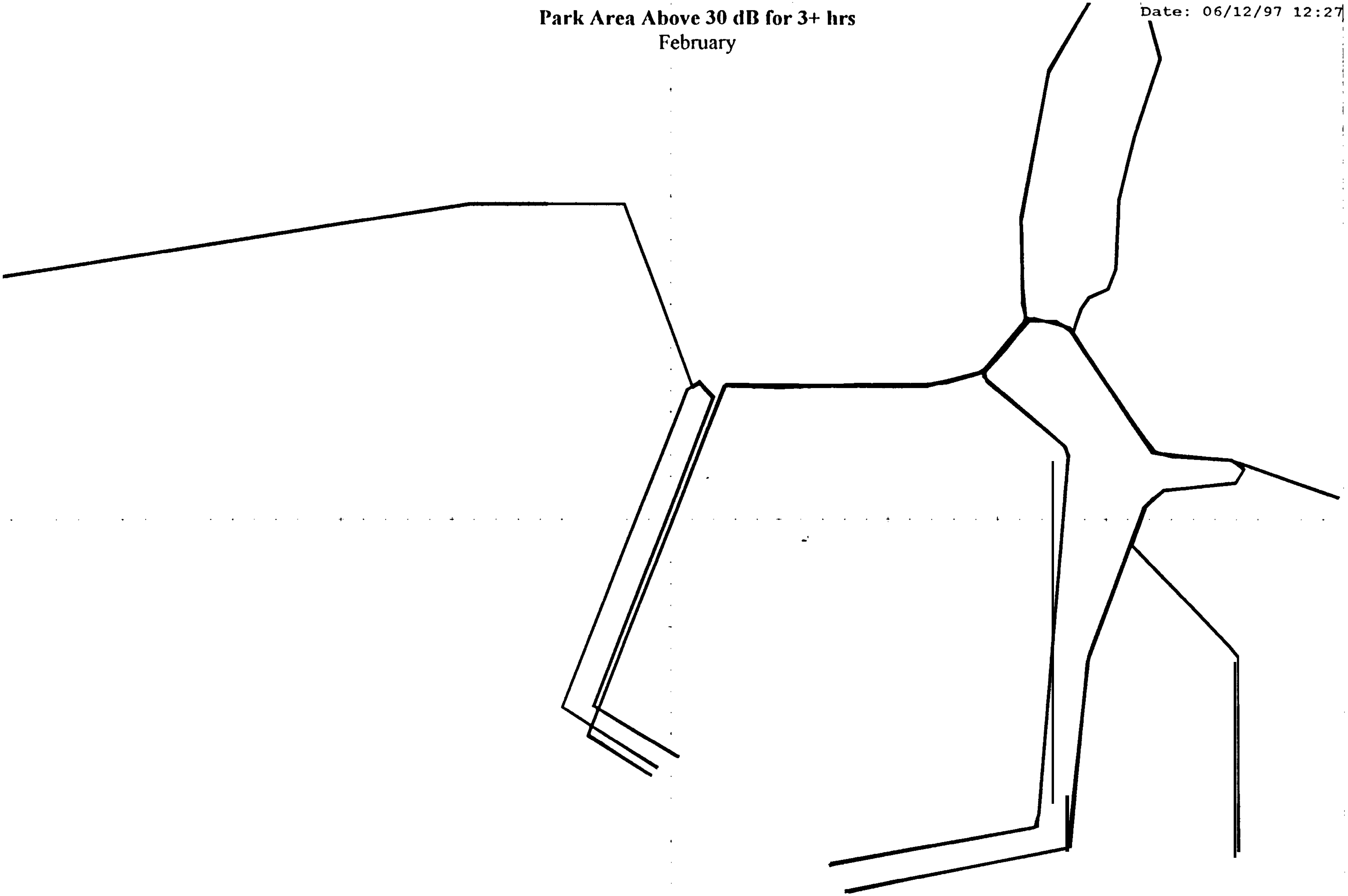


(no area with more than 3 hrs of exposure)

GRANDCAN\CASE2
Scale: 1 in = 4 nmi
Metric: TALA

Park Area Above 30 dB for 3+ hrs
February

Date: 06/12/97 12:27

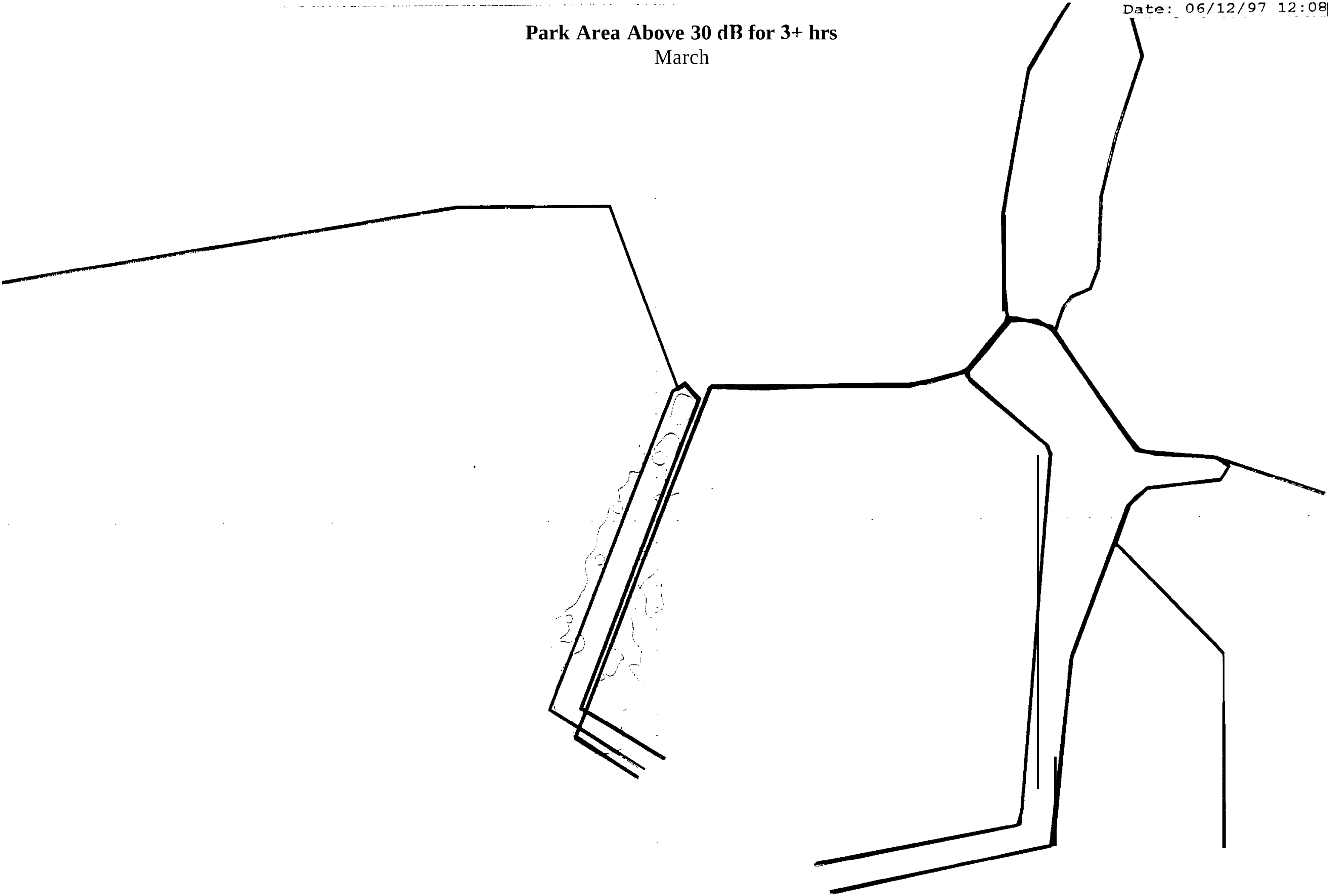


(no area with more than 3 hrs of exposure)

RANDCAN\CASE2
cale: 1 in = 4 nmi
etric: TALA

Date: 06/12/97 12:08

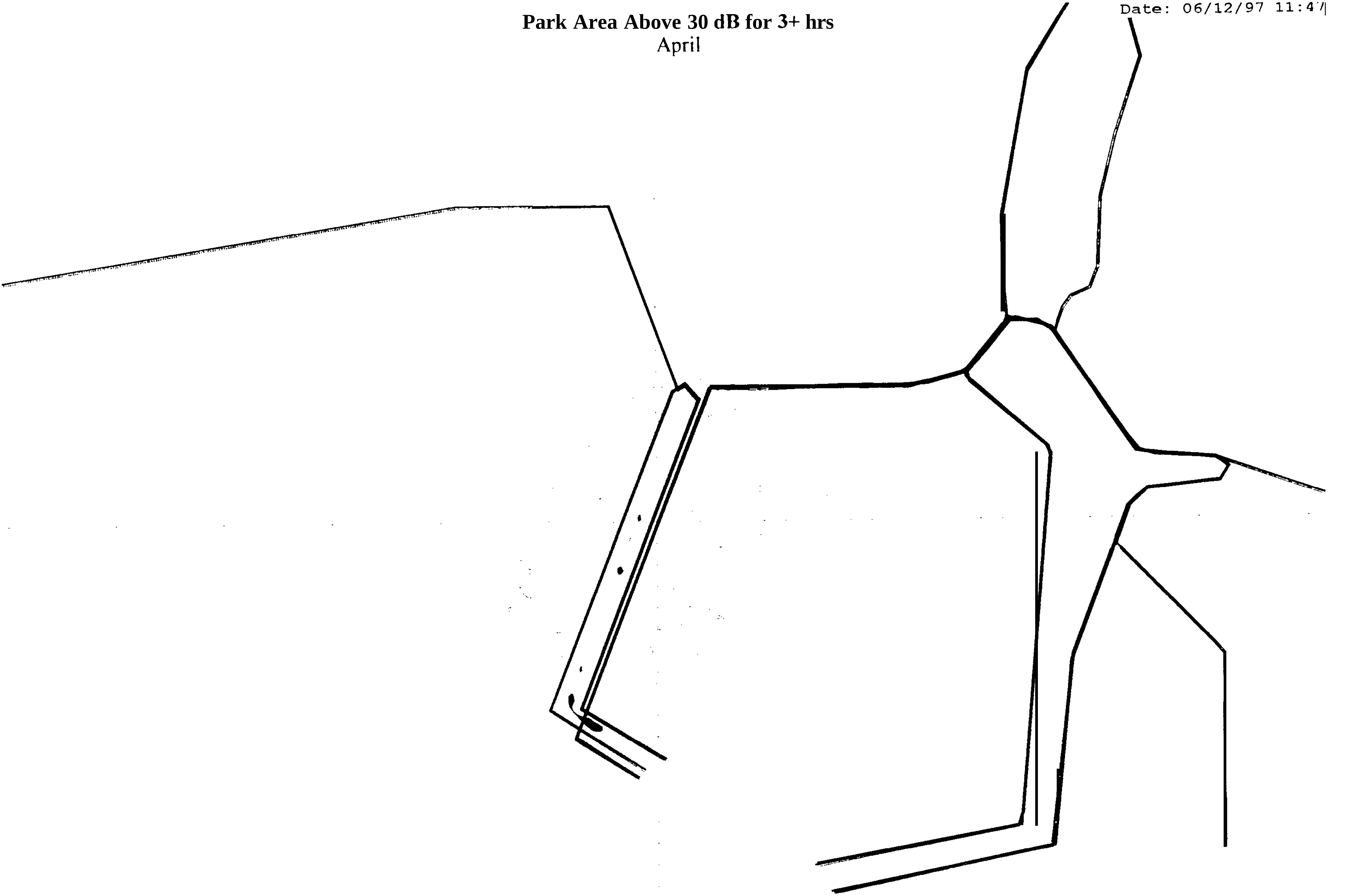
Park Area Above 30 dB for 3+ hrs
March



RANDCAN\CASE2 Level 180.0
cale: 1 in = 4 nmi Sq.mi 34.21
etric: TALA Color

Date: 06/12/97 11:4?

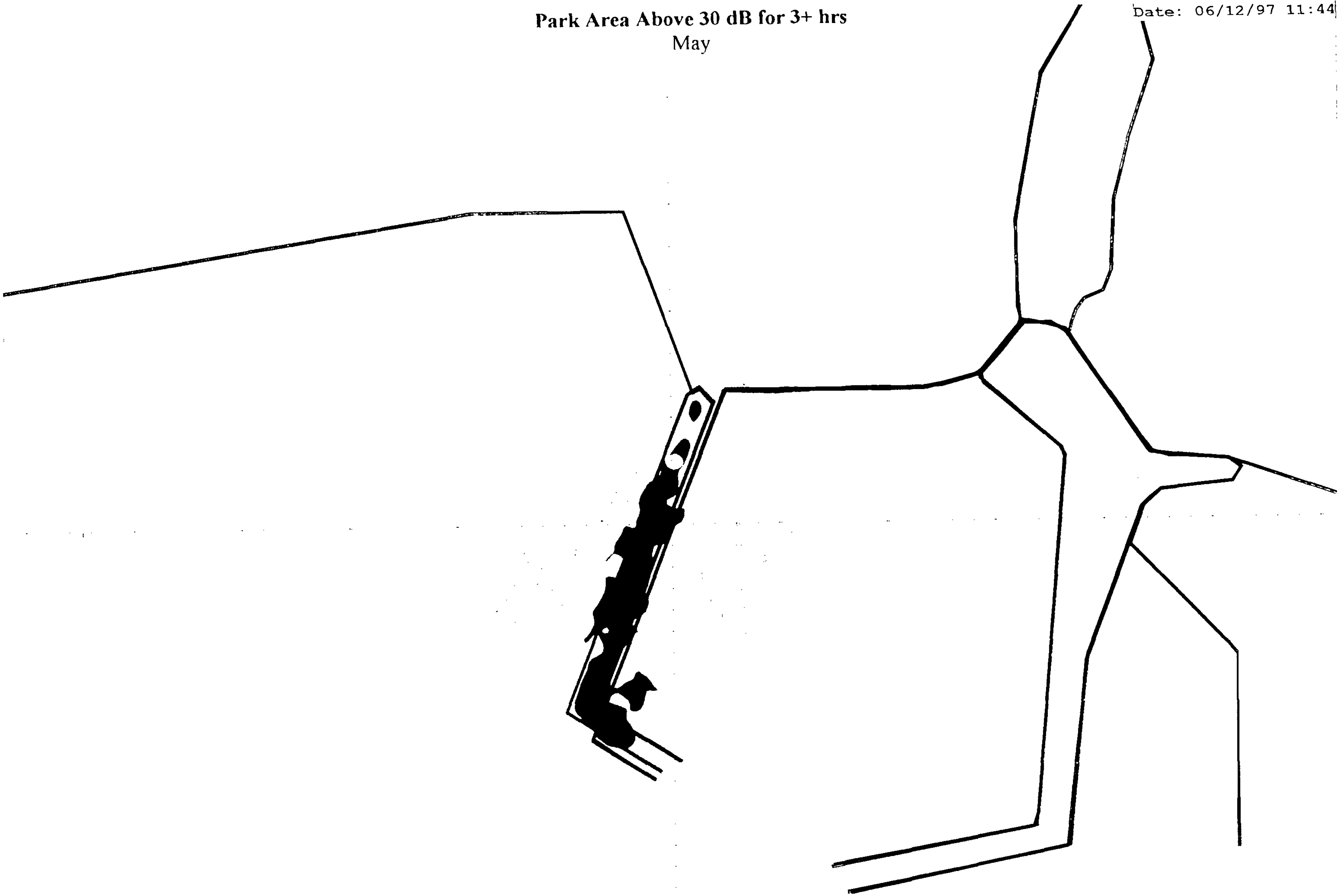
Park Area Above 30 dB for 3+ hrs
April



RANDCAN\CASE2 Level 180.0 360.0
cale: 1 in = 4 nmi Sq.mi 95.29 0.69
etric: TALA Color

Date: 06/12/97 11:44

Park Area Above 30 dB for 3+ hrs
May

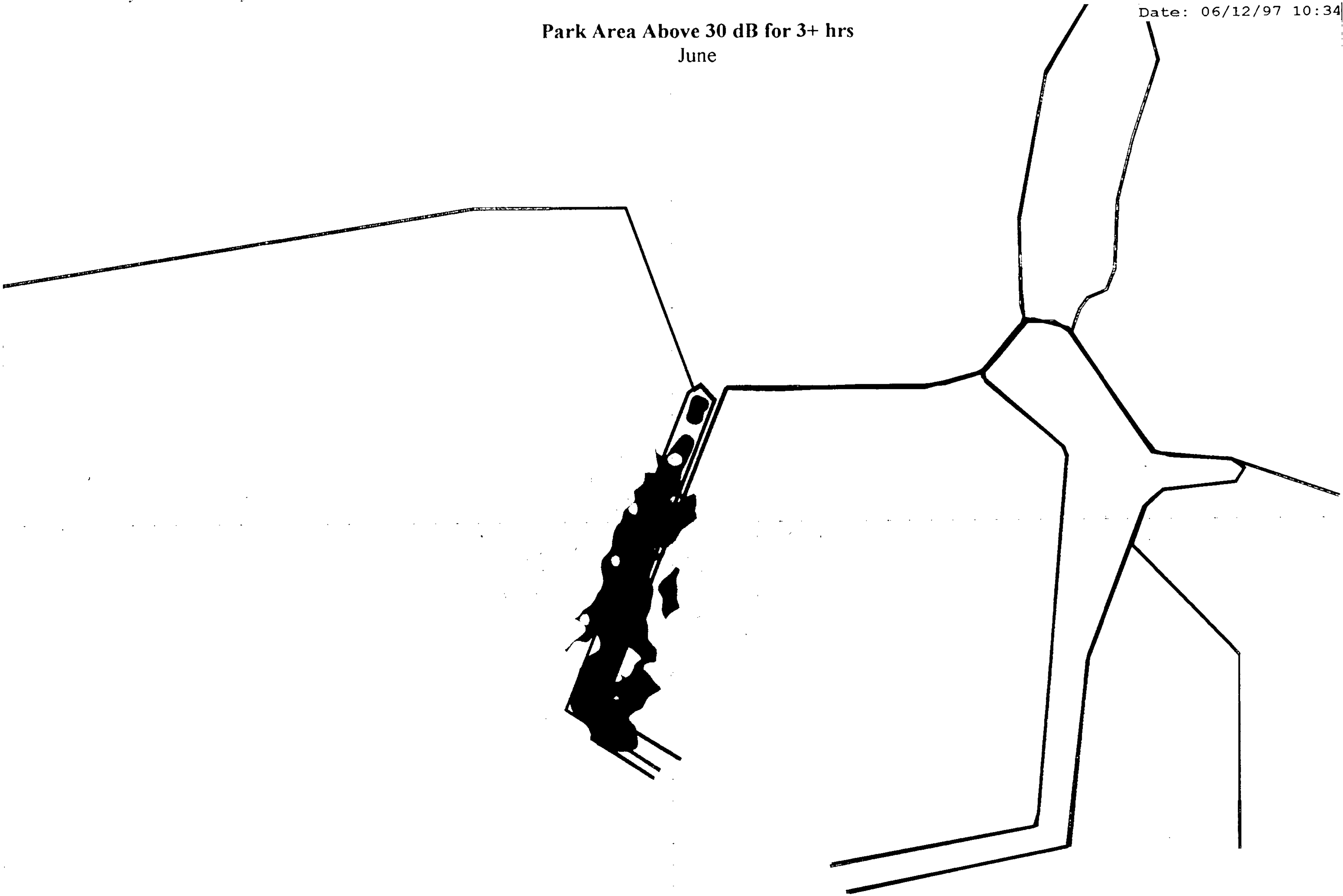


GRANDCAN\CASE2 Level 180.0 360.0
Scale: 1 in = 4 nmi Sq mi 123.37 21.22

Date: 06/12/97 10:34

Park Area Above 30 dB for 3+ hrs

June



GRANDCAN\CASE2 Level 180.0 360.0

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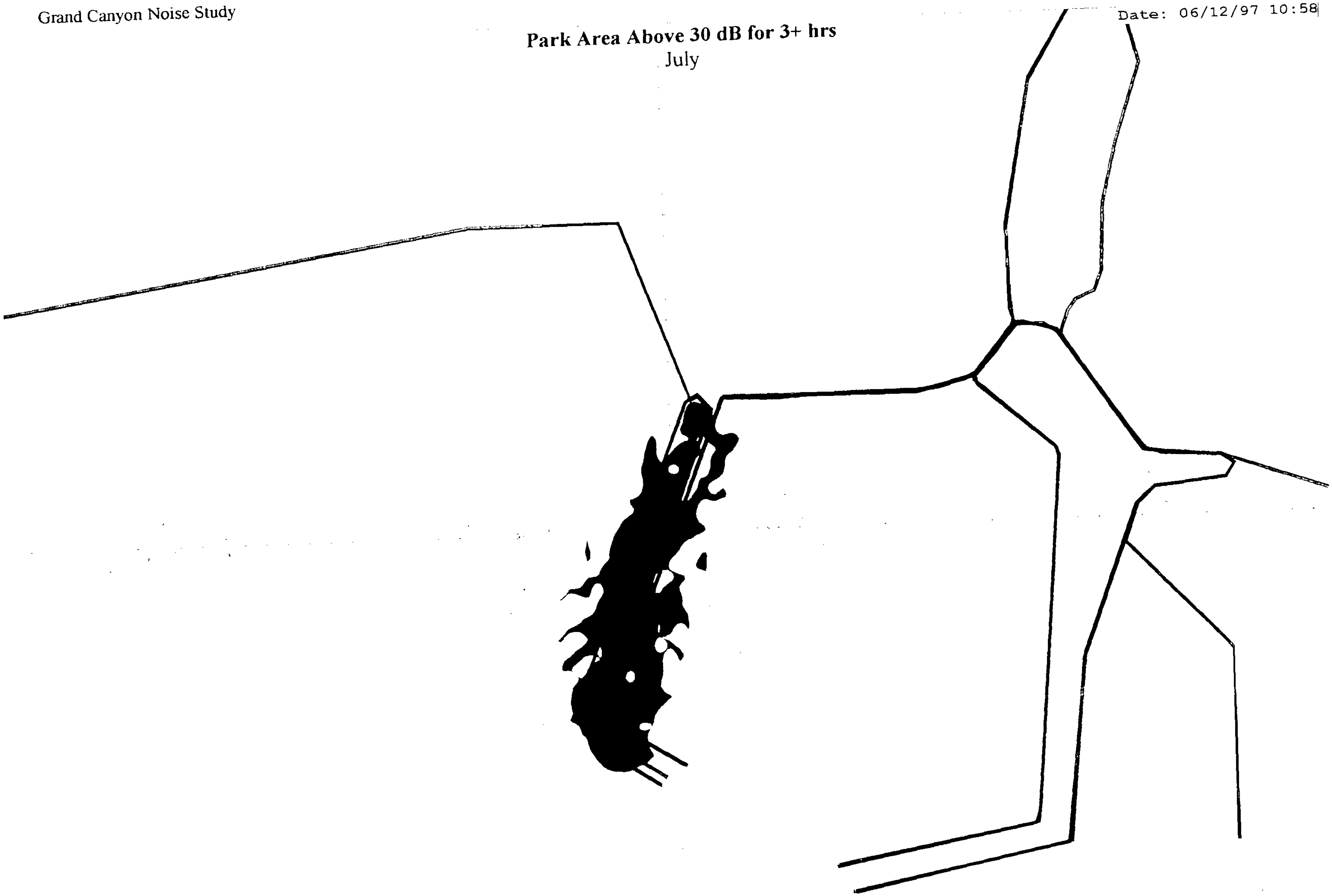
Park Area Above 30 dB for 3+ hrs

July

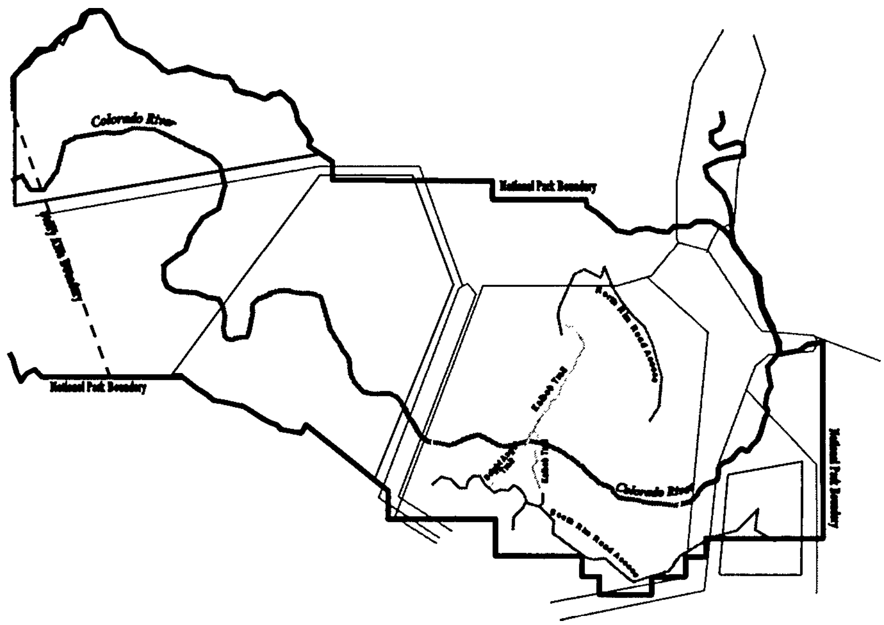


[redacted]DCA[redacted]SE2[redacted] Le[redacted] 180[redacted] 360[redacted]

E N G I N E E RIN G

ANALYSIS REPORT

JRE DOCUMENT JR 182
Revision A



ANALYSIS OF NATIONAL PARK SERVICE DATA ON AIR TOUR OVERFLIGHT SOUND AT GRAND CANYON NATIONAL PARK

Preparedfor.

Helicopter Association Internntionnl
On behalf of:
Papillon Airways, Inc.
***12.515** Willows Road, N. E.*
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September 3, 1999

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ANALYSIS REPORT

JRE DOCUMENT: JR 182
Revision A

*ANALYSIS OF NATIONAL **PARK SERVICE** DATA **ON AIR** TOUR **OVERFLIGHT** SOUND AT GRAND CANYONNATIONAL PARK*

Prepared for:

Helicopter Association International
On behalf of:
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Initial release, July 25, 1997
Revision A, September 3, 1999

LOG OF REVISIONS

Rev	Date	Affected Pages / Changes	Initial
A	3SEP1999	Generally: Updated sound contours to cover the entire Park and incorporate INM 5.2. FAA discovered that INM 5.1 (used in the original release) did not correctly compute the time above metric, and has corrected that error in INM 5.2. The threshold of noticeability was changed from 30 dB(A) to 29 dB(A) based on a conservative analysis. Added or Replaced Pages: Cover, i, ii: Rev A iii: Changed Titles of Sections 2.2.2 Apndx A iv: Added Table 2.0, deleted Table 2.2 1.1 Updated numbers 2.2 Deleted last sentence 2.2a, 2.2b: Added Pages: Develop threshold of noticeability 2.3, 2.4: Changed footnotes to INM 5.2 2.8: Updated numbers, replaced Table 2.2 w/ bulleted list.	JRA

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REFERENCES:

1. *"Draft Environmental Assessment -- Special Flight Rules in the Vicinity of Grand Canyon National Park':* Jeff Griffith (ATA- 1), FAA/BIA/NPS, 8/20/96

2. NPOA Report *No.* 93-1, *"Evaluation of the Effectiveness of SFAR 50-2 in Restoring Natural Quiet to Grand Canyon National Park --Final Report",* S. Fidell, K. Pearsons, M. Sneddon, BBN Systems and Technologies, 6/23/94.

3. *"Draft Environmental Assessment – Noise Limitations for Aircraft Operations in the Vicinity of Grand Canyon National Park",* Jeff Griffith (ATA-1), FAA/NPS, 12/24/96

4. Noise-Con 96 Paper, *"Barrier Diffraction and Sound Propagation in USDOT's New Traffic Noise Model"* , C.W. Menge, et al, Harris, Miller, Miller & Hanson, 6/96

1.0 INTRODUCTION

1.1 Summary

New restrictions on flight operations have been imposed on tour aircraft in Grand Canyon National Park. The basis for this change is government studies claiming that aircraft noise would be audible in large areas of the park under existing rules.

Our analysis shows, however, that the government studies were biased and misleading due to several invalid and unscientific assumptions that overstate the sound levels and sound detectability. For example, their studies zero out the sound attenuating effects of trees, loose soil and other surface features. Their studies further assume a threshold of detectability that is lower than that shown by the government's own research.

When these errors are corrected, the result is that 94% of the Park will meet the Park Services own definition of "natural quiet" in the busiest month for air tours (July).

We have evaluated this hypothesis from two different analytical perspectives:

Study A: The INM 5.0 study commissioned by the National Park Service (NPS) and performed by the Federal Aviation Administration (FAA), as reported in the Draft Environmental Assessment, Reference 1. This study was used by the NPS to justify more restrictive flight rules.

Study B: Our INM 5.2 study of operations in the Park using actual 1996 aircraft operations as reported by the operators and FAA. This reflects what actually happened in 1996.

Even tested against the NPS's rather extreme and controversial definition of "substantial restoration of natural quiet," each of these analyses demonstrates that "natural quiet" has been restored under SFAR 50-2. These results are particularly compelling in the case of Study A since:

(a) This study, was conducted on behalf of NPS, using the NPS's and FAA's data, and;

(b) This study was not a neutral analysis and based on generally accepted practices in evaluating aircraft noise. Certain assumptions were made in the methodology of this study. These assumptions systematically bias the results in a manner that has the effect of obscuring the fact that "natural quiet" had been restored under SFAR 50-2.

1.2 Objective

The objective of this report is to explore and illuminate the assumptions underlying the government study of noise in Grand Canyon National Park, and to provide a technically neutral evaluation of the "restoration of natural quiet" therein.

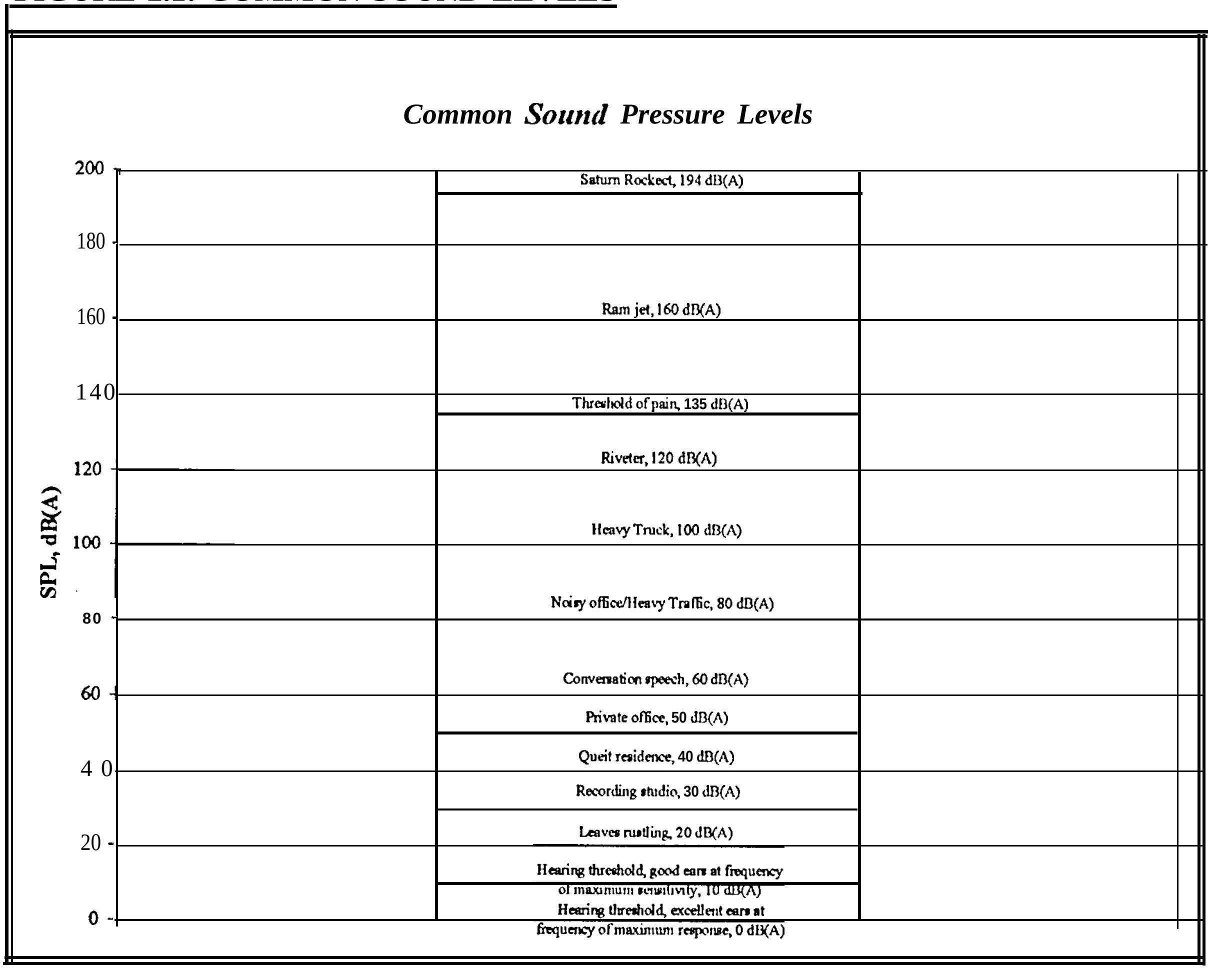
2.0 ANALYSIS

2.1 What Is "Natural Quiet?"

The National Park Service (NPS) in its 1994 Report to Congress, stated that "substantial restoration of natural quiet" will have occurred when at least 50% of the park is free of noticeable noise from sightseeing flights at least 75% of the time. (This definition has been challenged in court as too extreme, but our analysis shows that even this very demanding standard for "natural quiet" has been and is being met. It is being met, in fact, in far more than 50% of the Park.)

The Draft Environmental Assessment that accompanied the new Grand Canyon rules (Reference 3) indicates that the NPS has defined "noticeability" to mean a 3 dB(A) increase above the ambient sound level at any particular location. It has, further, assigned ambient noise levels in the neighborhood of 15 dB(A) to 17 dB(A) to most of the Park. These levels barely exceed the threshold of hearing (See Figure 2.1) and would be exceeded by rustling leaves, any hint of wind, or hikers' footsteps.

FIGURE 2.1: COMMON SOUND LEVELS



The BB&N study conducted in 1994 under NPS contract and reported in Reference 2 provides a more useful data set. This study found that 30 dB(A) is the average level at which observers sent into the Canyon first detected aircraft noise above the ambient level (onset), and were no longer able to detect the aircraft sound (offset). This is shown in Figure 2.2 (Figure E-4 from Reference 2)[1].

Reference 2 also correctly observes (Section 4.8) that noticeability of aircraft noise for someone not specifically engaged in listening for aircraft noise would occur at a 10 dB higher signal to noise ratio than for a vigilant observer.

FIGURE 2.2: MEAN SOUND LEVEL AT ONSET AND OFFSET OF DETECTABILITY
(Figure E-4 from Reference 2)

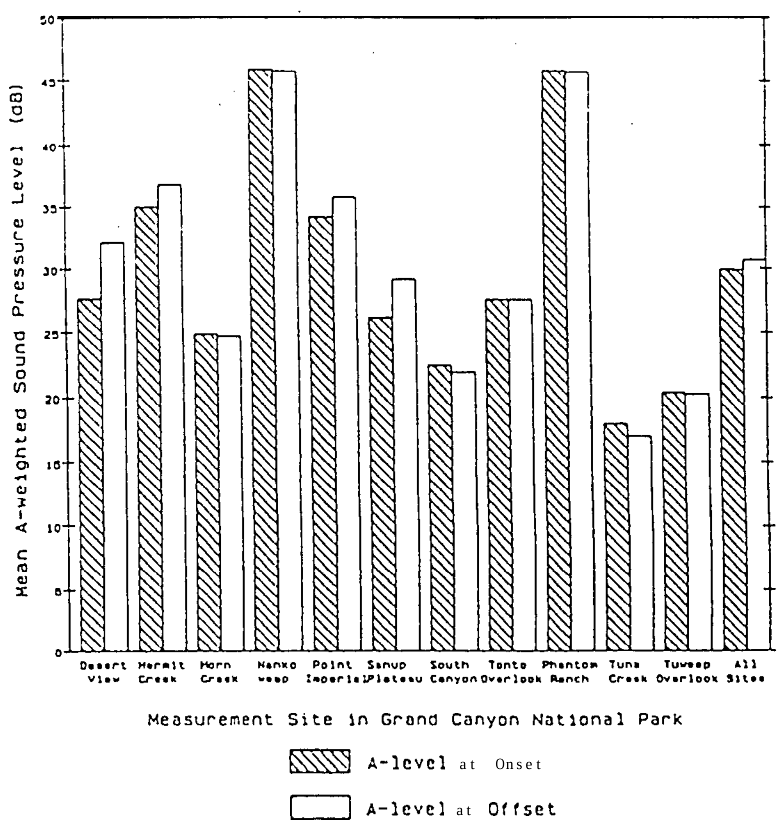


Figure E-4 Mean A-weighted sound pressure levels by site at onset and offset for air tour aircraft.

[1] Note that 30 dB(A) is the average level for onset and offset of detectability, individual sites having higher or lower levels. Since, the NPS criterion for "substantial restoration of natural quiet" requires that a "natural quiet" exist in 50% of the park, an average level is appropriate.

2.1.1 DETERMINING THE THRESHOLD OF NOTICEABILITY

2.1.1.1 Notes on Sound *Detectability* (or Audibility) and *Noticeability*

- The detection of aircraft sound by humans (or sound analyzers) requires some increase in sound level above the ambient level with no aircraft present. That is the Signal to Noise Ratio, S/N, must be greater than zero.
  - For example, the sound measurements conducted in GCNP in Reference 2 found that observers at 13 different sites in GCNP (intently listening for aircraft) were able to detect aircraft at an average S/N of 1 dB(A).
  - This A-weighted Overall S/N=1 dB(A) is consistent with detectability of aircraft sound 6 dB(A) below ambient. Reference 2 acknowledges that one cannot reliably measure broadband sound levels (such as dB(A)) that are below ambient.
- Reference 2 also made use of a commonly used measure of acoustical detectability in the presence of masking sound known as "d-prime" or bandwidth adjusted signal to noise ratio,

  $d' = \eta * S/N * \sqrt{(W)}$,

  where,

  d' is computed for every 1/3 Octave band

  η = detector efficiency (set to 40%, in *Reference 2)*

  W = critical bandwidth of the ear (~100Hz to -150 Hz in the area of interest)
  - For convenience the decibel equivalent, 10LOG(d') is often used. Typically, a prop or rotor blade passage tone will betray the presence of an aircraft. The band containing that tone typically has the highest d'.
  - The observers in Reference 2 found *detectability* at 10LOG(d') = *7* and *noticeability* at 1 0LOG(d') = 17

2.1.1.2 Computation of Threshold of Noticeability

- We based our computations on the observations reported in Reference 2.
- We accepted the 3 dB above ambient definition of the threshold of noticeability used by NPS in its previous studies.
  - The NPS's definition of "substantial restoration of natural quiet" requires that 50% or more of the Park be free of noticeable aircraft sound 75% or more of the time. To determine the corresponding threshold of noticeability:
  - We determined the lower quartile sound level at which aircraft were detected at each site. Thus the detection level was higher 75% of the time.
  - We then computed the median of those site-specific, lower quartile sound levels. Thus the detection level was higher 75% of the time at 50% of the sites.
- The finding in Reference 2 that S/N = 1 dB(A) at detection means that the ambient level was 1 dB(A) below the detection level. Thus, subtracting 1 dB(A) and adding 3 dB(A) to the median lower quartile detection level yields the threshold of noticeability.
- Table 1 shows the computations. The median lower quartile threshold of noticeability is 28.93 dB(A) at onset and 28.796 dB(A) at offset. Averaging and rounding yields 29 dB(A). This is the correct aircraft sound criterion level for evaluating "substantial restoration of natural quiet". If aircraft sound is less than 29 dB(A) 75% or more of the time in 50% or more of the Park, then, by the NPS's definition and the NPS's data, "substantial restoration of natural quiet has occurred".

TABLE 2.0: COMPUTATION OF THRESHOLD OF NOTICEABILITY

	La at Onset of Detectability				La at Offset of Detectability			
	Mean		25%ile La		Mean		25%ile La	
Site	La, dB(A)	std dev, s	=La-.67s		La, dB(A)	std dev, s	=La-.67s	
Horn Cr.	24.9	2.3	23.359		24.7	3.2	22.556	
Nankoweap	45.9	7.8	40.674		45.8	7.8	40.574	
Pt Imperial	34.2	4.3	31.319		35.8	5.8	31.914	
S. Canyon	22.5	3	20.49		22	3.7	19.521	
Hermit Cr.	35	8.3	29.439		36.8	9.4	30.502	
Sanup Plateau	26.2	4.9	22.917		29.2	7.5	24.175	
Tonto Overlook	27.6	1	26.93		27.6	1.2	26.796	
Phantom Ranch	145.8	11.2	144.996		145.7	1.6	44.628	
Tuna Cr.	18	1.2	17.196		17.1	1.8	15.894	
Toroweap Overlook.	20.4	2.6	18.658		20.3	1.7	19.161	
Desert View	27.7	0.7	27.231		32.1	4.5	29.085	
MEDIAN, dB(A)	27.6		26.93		29.2		26.796	
Ambient, SNR=1 dB(A)	26.6		25.93		28.2		25.796	
Noticeability Threshold								
= amb + 3 dB(A)	29.6		28.93		31.2		28.796	
Data from NPOA Report 93-1, Table E-3								

2.2 Noise Projections Using Integrated Noise Model (INM)

FAA developed the Integrated Noise Model (INM) for use in calculating community noise impacts in the vicinity of airports. This model is inherently conservative for application at the Grand Canyon because it does not fully account for the blocking effect of terrain between the source and observer. Version 5.1 is the most recent release of INM.

2.2.1 Study A: FAA INM 5.0 Study (Reference 1): Assumptions Leading to Overstatement of Noise Impact

The INM 5.0 noise analysis commissioned by the NPS incorporates a number of unusual and erroneous assumptions that consistently cause overstatement of noise impact. These biasing errors include:

2.2.1.1 Incorrect Helicopter Speed Correction

Reference 3, Table 4.1.2a, shows that the government **increased** helicopter sound levels taken from the Helicopter Noise Model (HNM)[2] by 1.1 to 1.5 dB. This ostensibly corrects the Sound Exposure Level (SEL) from test speed (116 – 128 kt) to Grand Canyon tour cruise speed (90 kt)[3].

The HNM, however, shows SEL **decreasing** as airspeed decreases to 90 kt[4]. The effect of this error is to overstate helicopter sound levels in the Grand Canyon.

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[2] HNM is an FAA developed program for computing sound from helicopters. FAA states that it plans to incorporate the HNM in the Integrated Noise Model (INM). The present INM Version 5.2 data base contains only fixed wing aircraft.

[3] This appears to be a correction for sound duration based on 10LOG(Vref/V). It ignores the more powerful effect of advancing tip mach number on helicopter sound. The reduction in advancing tip mach number at lower air speed causes the time integrated sound level, Sound Exposure Level (SEL), to decrease or remain the same, as airspeed decreases.

[4] We computed and averaged SEL directly under the flight path and 500 ft to either side, for a 500 ft flyover using HNM version 2.2. This produced the following:

- Aerospatial AS350D, SEL = 83.2 dB at 116 kt, 83.0 dB at 90 kt, a 0.2 dB reduction.
- Bell 206L, SEL = 82.2 dB at all speeds, no speed correction provided..

2.2.1.2 Elimination of Lateral Ground Sound Attenuation from the INM.
(This is sound absorption by ground and attenuation through disturbed air near the ground, not blocking by a barrier.)

The government **altered the code of INM Version** 5.0 to remove the computation of lateral over-ground attenuation'. This alters the program's basic computational method in a way that is inconsistent with all other sound studies conducted with this program, including those conducted under FAA regulation. The effect of this alteration is to overstate sound levels of all aircraft in the Grand Canyon.

The reason given for this alteration of the INM is that lateral over-ground attenuation *"is oriented toward acoustically soft, grassy terrain unlike that found at the Grand Canyon".* This assertion is difficult to reconcile with the following:

1) As noted in Reference 3, much of the terrain above 2000 meters (6560 A) is covered with conifer forest or other vegetation. These areas are very "soft", acoustically. Further, lateral over-ground attenuation occurs mainly in these higher elevation areas where sound propagation from an aircraft at 7500 to 9500 ft is more nearly horizontal compared with propagation to lower elevation points[6].

[5] The final EA, Reference 3, states (Section 4.1.2) that *"The INM is the FAA's standard computer methodology for assessing and predicting aircraft noise impacts. It's use in regulatory actions is governed by FAA Order 1050.1D, 'Policies and Procedures for Considering Environmental Impacts', under the National Environmental Policy Act (NEPA)."*

As provided to the acoustical engineering community by the FAA, INM version 5.0 (or the latest version, 5.1) does not have a user selectable input to turn lateral attenuation **OFF.** Thus, when used pursuant to Order 1050. 1D, lateral attenuation is always ON.

[6] The INM lateral over-ground attenuation model produces maximum attenuation for horizontal propagation, decreasing to zero as elevation angle increases to 60° or more.

- Thus, for an aircraft flying at 9000 A, MSL, the elevation angle from an observer on the canyon floor (3800 A, MSL), 3000 ft to the side would be arcTAN((9000-3800)/3000) = 60° and the INM would have calculated zero lateral over-ground attenuation, altered or not.
- For an observer on the forested north rim at 8000 ft, MSL (and 3000 A to the side), the elevation angle would be arcTAN((9000-8000)/3000) = 18.4" and the unaltered INM would (quite correctly) have calculated a 3.6 dB lateral over-ground attenuation. The FAA-altered INM would, thus, overstate the noise level by 3.6 dB, in this example.

2) Loose, dry dirt and gravel (in addition to grass, shrub and other vegetation) are common in areas of the canyon where people are likely to be (i.e. places other than sheer canyon walls). This terrain is nearly as "soft" acoustically as a grass lawn.[7]
3) In addition to the impedance match of earth and air, lateral over-ground attenuation is affected by disturbance of the atmosphere by the ground, including wind turbulence and temperature gradients.
4) If it is correct to alter the INM such that lateral over-ground attenuation is disabled whenever some acoustically "hard" terrain exists in the area of interest, then: this alteration should be required when the INM is used, under FAA oversight, to predict sound around urban and suburban airports where parking lots, freeways, buildings, bodies of water or other acoustically "hard" areas may be present. This alteration is, of course, never done (outside of the Grand Canyon) and cannot be done by an engineering user outside of FAA.
5) The EA (Reference 1) offers Appendix C (an 8/9/94 Memo from Gregg Fleming) to prove the validity of eliminating of lateral over-ground attenuation in this application. Appendix C compares measured levels in the Grand Canyon with predictions by the altered INM.
6) The data presented in Appendix C, however, shows that the INM predictions (without lateral ground attenuation) usually exceeded the corresponding measurements. Figure 2.3 (Figure 2 from Reference 1, Appendix C) shows this for DHC-6 Twin Otters. The text of Appendix C acknowledges the following over-predictions:

   (a) A 3 dB average over-prediction in this case (DHC-6) at sites 1 and 2[8];
   (b) A 2 dB average over-prediction for a mix of Cessna 182, 207 and 414A aircraft at sites 1 and 2[9];
   (c) A 0.5 dB average over-prediction of a mix of Bell models 206 and 206L and Aerospatiale models 350 and 355 helicopters at sites 1 and 2.[10]
   (d) A 1.7 dB average over prediction for 13 hourly LEQ measurements and predictions at two sites (3 and 15)
   (e) A 9.9 dB average over-prediction for 9 hourly LEQ measurements and predictions at Site 16.

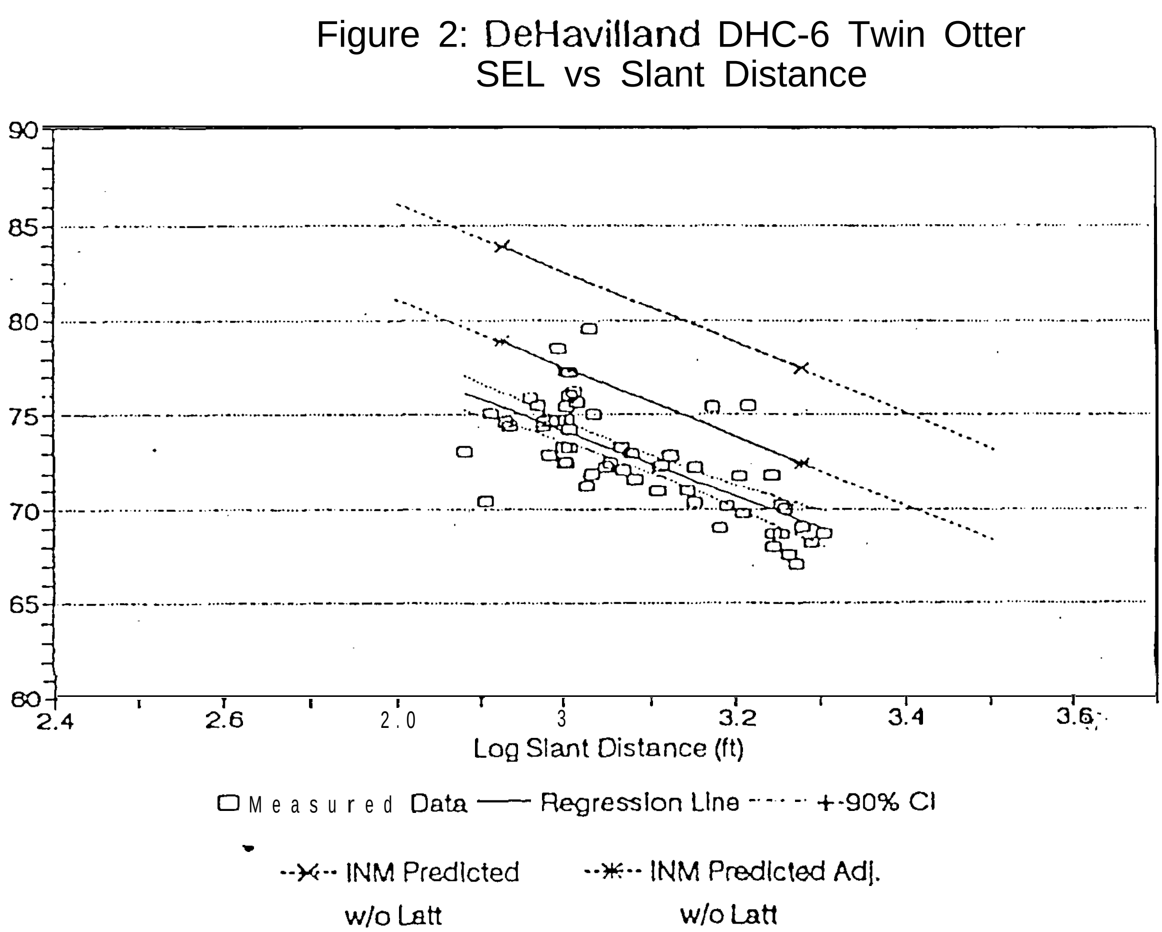
[7] The US Department of Transportation's TNM (Traffic Noise Model), used to compute over-ground sound propagation around highways, assigns a 300 cgs Rayl effective impedance to lawn grass and 500 cgs Rayls to loose soil and gravel. For comparison granular snow is assigned 40 cgs Rayls (very soft) and pavement or water 20,000 cgs Rayls (very hard). From Reference 4.

[8] Slant range varied from about 500 ft to 2000 ft. Elevation angles were not given, but it is probable that many data points were at high elevation angles where the unaltered INM would have calculated little or no lateral over-ground attenuation. Thus the over-prediction could be greater at larger lateral distances.

[9] Slant range varied from about 700 A to 2500 ft. Comment from footnote 8 applies.

[10] Slant range varied from about 300 ft to 3000 A, with most of the data points between 300 ft and 1000 ft. Comment from footnote 8 applies.

FIGURE 2.3: COMPARISON OF MEASURED DHC-6 SOUND LEVEL WITH PREDICTION INM 5.0 WITH LATERAL OVER GROUND ATTENUATION DISABLED
(Figure 2 from Reference 1, Appendix C)



2 2.1 3 Assumption of 12-Hour Day

The NPS's INM 5.0 study assumes that a day is 12 hours long, rather than 24 hours long. This assumption increases LAEQ values 3 dB above their 24-hour day values. This also doubles the percent time above a threshold sound level (%TA) values compared with a 24 hour day.

24 - hour users of the Park such as, back country hikers and river corridor users are the most noise sensitive groups.

2.2.1.4 "Natural Quiet" Restored in Spite of Bias

Table 2.1 (Table 4.6' from Reference 1) shows that, even with the biasing effects of the above assumptions, the tour aircraft noise level was below 30 dB(A) 75% of the time in 2267 – 322 = 1945 square miles of the 2267 square mile study area. In other words, 86% **of the park was free of noticeable tour aircraft noise 75% of the time.** This more than meets the NPS definition of "substantial restoration of natural quiet."

TABLE 2.1: AREAS WITHIN 25% TIME ABOVE CONTOURS FROM GOVERNMENT INM 5.0 STUDY

(Table 4.6 from Reference 1)

Table 4.6

% Time Above Contour Areas

	1995 Base Case		1995 Alternative		% Change from Base Case
	%TA Contour Area (Sq. Mi.)	% of Analysis Area (2,267 Sq. Mi.)	%TA Contour Area (Sq. Mi.)	% of Analysis Area (2,267 Sq. Mi.)	
10	758.12	33.4%	901.77	39.8%	15.9%
20	549.04	24.2%	516.99	22.8%	-6.2%
25	465.55	20.5%	415.76	18.3%	-12.0%.
30	321.67	14.2%	282.59	12.5%	-13.8%
40	136.50	6.0%	149.76	6.6%	8.9%
50	80.03	3.5%	99.91	4.4%	19.9%
60	65.25	2.9%	57.53	2.5%	-13.4%
70	52.77	2.3%	42.82	1.9%	-23.2%

One would have to assume a threshold of noticeability below 10 dB(A) in absolute terms to find that "natural quiet" had been "substantially restored" to less than half of the park. Any reasonable understanding of the science of acoustics cannot support such a low threshold.

2.2.2 Study B: INM 5.2 Study of 1996 Tour Aircraft Operations Using Actual Operations Data

This study was conducted over the entire Park, but is broken into 3 overlapping sectors, East, Central and West, due to software limitations.

Tour operators provided aircraft operations data for the East end for the months of January through July. The FAA 1996 study provided operations data for the remainder of the Park. Appendix A provides contours of the time above the threshold of noticeability (29 dB(A)) for each month.

Our study used July operations data, the busiest month for which we had complete data and one of the busiest months of the year.

Note that the largest time above contour is for 180 minutes (3 hours). The smaller, 360 minute (6 hours) contour is the significant one, representing 25% of 24 hours. Appendix A also details the underlying assumptions and sources of this information.

Appendix A shows that actual July 1996 air tour operations throughout the Park easily met the NPS definition of "substantial restoration of natural quiet." (At least 50% of the Park free of noticeable tour aircraft noise at least 75% of the time.)

- NPS gives Grand Canyon National Park as encompassing 1.2 million acres, or 1875 square miles.
- Air tour sound exceeded 29 dB(A) more than 360 minutes per day (25% of 24 hours) in 110 square miles, or 6% of that area.
  - Thus 94% of GCNP met the NPS's definition of "natural quiet".
- Even using the incorrect assumption that a day is 12 hours, we find that air tour sound exceeded 29 dB(A) more than 180 minutes per day (25% of 12 hours) in 400 square miles or 21% of the Park.
  - Thus 79% of GCNP met the NPS's definition of "natural quiet" using a 12 hour day.
- A larger study area would show similar area percentages.

Appendix B provides clear overlays showing these contours with respect to the park topographical contours and the areas where visitors actually spend time in the park. Overlaying the latter on the contours of Appendix A shows that, even in the busiest months, only a fraction of back country users (0.7% of visitor days) and River Corridor users (2.6% of visitor days), would experience anything other than "natural quiet" as a result of air tour operations. Hiking away from the Dragon Corridor (where most tours are conducted) would further minimize air tour sound impacts.

3.0 CONCLUSIONS

1. The government study shows that “substantial restoration of natural quiet” has occurred under SFAR 50-2 in spite of numerous invalid assumptions tending to bias the result in the opposite direction.

2. A technically neutral study shows that “substantial restoration of natural quiet” has occurred by an overwhelming margin under SFAR 50-2

APPENDIX A: GRAND CANYON INM NOISE STUDY SUMMARY

1 .O INTRODUCTION

In the fall of 1996, J R Engineering started looking at air tour noise in the Grand Canyon which included use of the FAA's Integrated Noise Model (INM) 5.0 which calculates noise levels produced by aircraft. Since then, the FAA has made numerous changes to the INM including changes in the way the Time Above noise metric is calculated. The Time Above metric is the unit used when checking that 50% of the park is quiet for 75% of the time. The most current version of INM, version 5.2, was used to calculate noise contours in this study.

The original study was limited in scope to the east end of Grand Canyon National Park. The average number of daily flights, aircraft type, and routes flown were provided by the tour operators who primarily flew over the eastern portion of the park. The air tour operators who provided data to us were Papillon, AGC, GCA, Scenic, Airstar, and Kenai. The contours shown in the east end of the park use these operators flight data from 1996.

Later on, the model was expanded to include flights over the western portion of GCNP. Since no flight data was provided, the number of operations that the FAA used in its 1996 study was used in J R Engineering's study of the west end of the canyon.

2.0 SFAR AIR TOUR FLIGHT PROFILES

The air tour flight paths and minimum altitudes are shown in the GCNP SFAR Aeronautical Chart. These were the flight paths input to INM to calculate noise contours. Minimum deviation from these flight paths was assumed. In some cases, the SFAR chart listed more than one altitude over a particular section of an air tour flight path. In these instances, it was assumed that the aircraft was on the lower flight path.

Figure 1 shows the flight paths taken from the SFAR chart.

All flight profiles in INM were created using the profile points method. Typically, aircraft used 60% thrust during cruise, 100% thrust during climb, and 20% thrust during descent. Cruise speed was assumed to be 90 KCAS.

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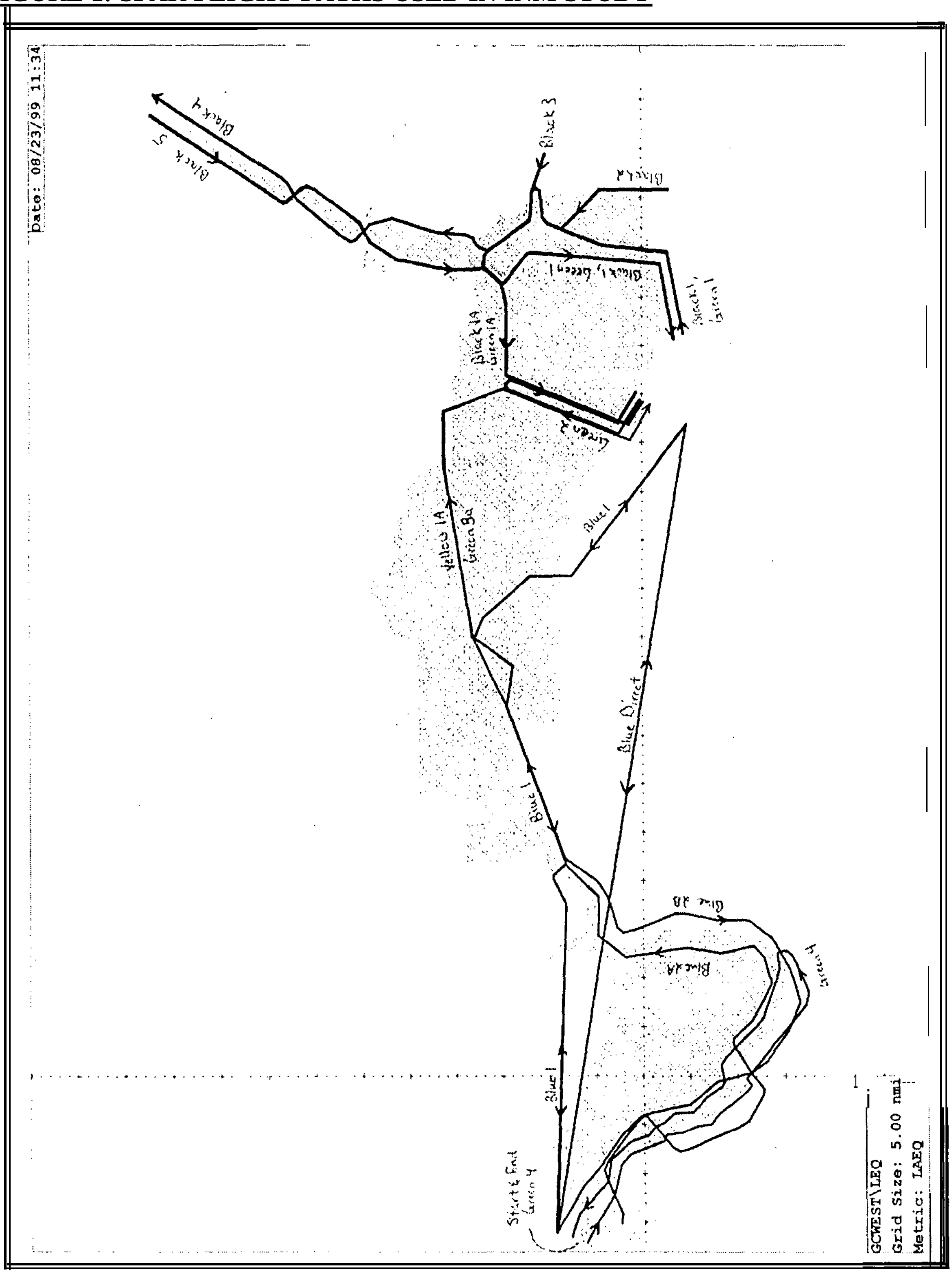
FIGURE 1: SFAR FLIGHT PATHS USED IN INM STUDY



3.0 AIRCRAFT NOISE LEVELS

The airplanes operating over the eastern portion of the park included the Cessna 172, 172R, 177, 18, 182R, 207, 208, and the DeHavilland DHC6Q. The helicopter operations on this end of the canyon included the Bell 206B, 206L-1, 206L-3, 206L-4, and the Aerospatial SA350D.

The DeHavilland DHC6Q, the Beech Baron 58P and various types of small single engine aircraft were used by the FAA in its study of noise in the western portion of GCNP. The Bell 206 was the only helicopter that was used in the FAA study covering the west end.

Most of the aircraft in the study had their NPD curves already included in the INM database. Some did not and NPD curves had to be calculated. Usually this was accomplished by adding a reasonable increment to the NPD of an existing similar aircraft.

The Cessna 207 was available as an approved substitute aircraft in INM. No changes were made to its database.

The noise curves for the Bell 206B, 206L-1, and 206L-3 were provided by John D'Aprile of the Volpe National Transportation Systems Center. The 206L-4 was incremented +.6 dB above the 206B. The DHC6Q noise curves were based on the noise curves in the INM for the DHC6 and reduced 5.1 dB based on data provided by Raisbeck Engineering, the makers of the quiet propellers.

Noise data for the SA350D was obtained from the Helicopter Noise Model (HNM) version 1 user's guide. An average of left, right and center sound levels was used and the advancing tip mach correction was applied to correct to 90 KCAS.

FIGURE 2: NON-STANDARD INM NOISE CURVES

NOISE_ID	NOISE_TYPE	THR_SET	CURVE_TYPE	L_200	L_400	L_630	L_1000	L_2000	L_4000	L_6300	L_10000	L_16000	L_25000
B206L	S	100.00	N	89.3	85.6	83.0	80.2	75.3	69.6	65.3	60.3	52.9	43.3
N206L4	S	1.00	N	89.9	86.3	83.4	80.8	76.0	70.5	65.3	60.9	56.3	52.1
N206L4	S	2.00	N	89.6	85.9	83.0	80.5	75.8	70.4	65.9	61.7	57.5	53.5
N206L4	S	3.00	N	94.8	91.5	88.9	86.8	82.8	78.0	73.8	69.7	65.6	61.6
NC206	S	1.00	N	89.3	85.7	82.8	80.2	75.4	69.6	64.7	60.3	55.7	51.5
NC206	S	2.00	N	89.0	85.3	82.4	79.9	75.2	69.8	65.3	61.1	56.9	52.9
NC206	S	3.00	N	94.2	90.9	88.3	86.2	82.2	77.4	73.2	69.1	65.0	61.0
NC350D	S	1.00	N	82.9	79.2	76.6	73.8	68.9	63.0	58.6	53.3	45.7	35.6
NC350D	S	2.00	N	82.6	78.8	76.2	73.5	68.7	63.2	59.4	54.1	46.9	37.0
NC350D	S	3.00	N	87.8	84.4	82.1	79.1	75.7	70.8	67.1	62.1	55.0	45.1
NDHC6Q	E	30.00	N	89.3	84.9	81.8	78.4	72.9	66.5	61.7	55.9	48.9	39.8
NDHC6Q	E	100.00	N	94.1	89.9	87.0	84.0	79.2	73.7	69.3	64.2	58.1	50.3
NDHC6Q	M	30.00	N	85.8	79.5	75.3	70.9	64.0	56.5	50.9	44.7	37.5	28.9
NDHC6Q	M	100.00	N	90.6	84.4	80.2	75.9	69.2	61.9	56.5	50.5	43.9	36.3
NDHC6Q	S	30.00	N	86.2	82.1	79.3	76.5	71.8	66.6	62.5	57.8	52.1	44.9
NDHC6Q	S	100.00	N	90.8	86.9	84.2	81.4	76.9	71.9	68.0	63.5	58.1	52.3

4.0 FLIGHT OPERATIONS

Figure 2 shows a summary of an average day flight operations for July 1996. July is typically the busiest month for air tours and has the most impact on visitors and the environment.

FIGURE 3: AVERAGE TOUR OPERATIONS JULY 1996

Flight Ops (By Flight Path)

ircraft Type	Flight Path	# of Ops
CT207A	21	0.4
GASEPF	21	0.4
GASEPV	21	0.4
CT207A	31	1.8
DHC6Q	31	0.7
GASEPF	31	2
GASEPV	31	0.2
BEC58P	B1AE	0.08
CT207A	B1AE	1.79
FWQ	B1AE	0.93
BEC58P	B1B2	0.1
FWQ	B1B2	0.03
BEC58P	B1Y1	24.87
CT207A	B1Y1	1.84
DHC6Q	B1Y1	27.16
FWQ	B1Y1	8.9
BEC58P	B2B1	0.09
FWQ	B2B1	0.03
BEC58P	BDE	24.46
CT207A	BDE	1.85
DHC6Q	BDE	26.64
FWQ	BDE	9.1
BEC58P	BDW	25.55
CT207A	BDW	3.64
DHC6Q	BDW	26.64
FWQ	BDW	10.03
B206	DRA	111.3
B206L4	DRA	9.8
SA350D	DRA	20.2
B206	FCC	3
B206	G4	5.75
SA350D	G4	25.58
B206	GC	19.7
B206L4	GC	1.7
CT207A	GC	33.1
DHC6Q	GC	26.5
SA350D	GC	3.6
CT207A	MAZU	0.5
DHC6Q	MAZU	2
GASEPF	MAZU	1.1
GASEPV	MAZU	0.2
CT207A	MC	0.3
GASEPF	MC	0.5
GASEPV	MC	0.2
CT207A	MC2	0.3
CT207A	MC2	0.7
DHC6Q	MC2	0.9
GASEPF	MC2	0.5
GASEPF	MC2	0.9
GASEPV	MC2	0.2
GASEPV	MC2	0.1
BEC58P	Y1B1	24.87
CT207A	Y1B1	1.84
DHC6Q	Y1B1	27.16
FWQ	Y1B1	8.9

	Flight Path Legend
21	Black 2 to Black 1 to Black 1a
31	Black 3 to Black 1
B1AE	Blue 1A Eastbound
B1B2	Blue 1 to Blue 2
B1Y1	Blue 1 to Yellow 1
B2B1	Blue 2 to Blue 1
BDE	Blue Direct East
BDW	Blue Direct West
DRA	Green 2 (Dragon Corridor)
G4	Green 4
GC	Black 1 to Black 1a (Zuni Pt. To Dragon)
MAZU	Black 5 to Black 1 (Marble Canyon to Zuni Point)
MC	Black 5 to Black 1a (Marble Canyon to Dragon)
MC2	Black 1 to Black 4 (Zuni Pt. To Marble Canyon)
Y1B1	Yellow 1 to Blue 1

	Aircraft Legend
B206	Bell 206B, 206L-1, or 206L-3 Helicopter
B206L4	Bell 206L-4 Helicopter
BEC58P	Beech Baron 58P
CT207A	Cessna 207A
DHC6Q	DeHavilland DHC6 with Quiet Propeller
FWQ	Unknown Plane that FAA used in its Study
GASEPF	General Aviation Plane Single Fixed Pitch Prop
GASEPV	General Aviation Plane Single Variable Pitch Prop
SA350D	Airstar SA350D Helicopter

5.0 TIME ABOVE 29 dB CONTOURS FOR JULY 1996

The following figures show the time that aircraft noise is above 29 dBA in July. This represents a worst case scenario in that July is the busiest time of year for air tours. Previous INM computations of the eastern portion of the canyon showed considerably less noise was produced in the fall, winter, and early spring months.

With the terrain feature turned on, INM can only handle a 1 degree latitude by 1 degree longitude study area. Since GCNP is over 2 degrees in width, the INM analysis was broken up into three areas. Since there is some overlap of area, the areas above 29 dBA shown at the bottom of each figure cannot be added directly.

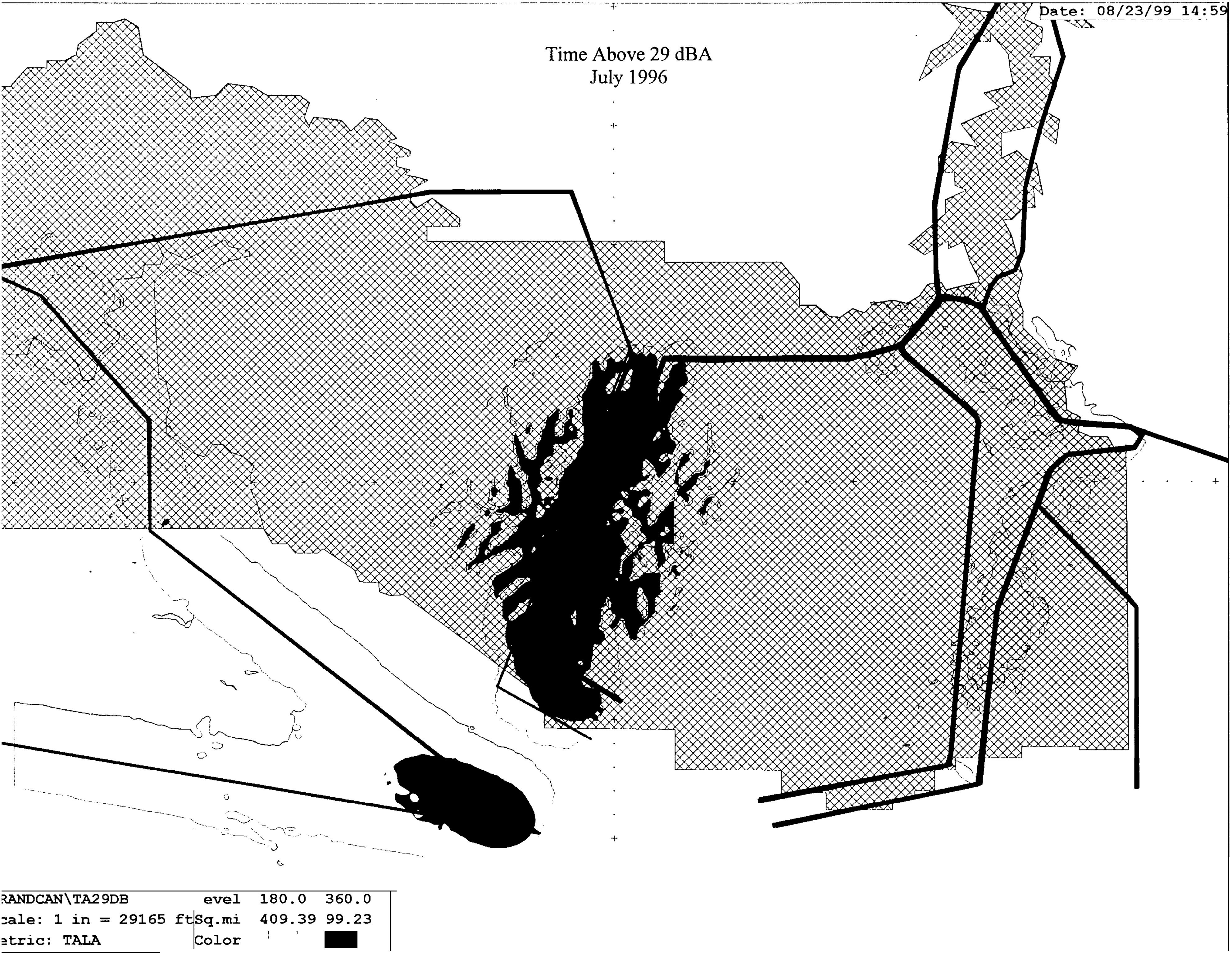
For a typical July day (1996 operations) the total area above 29 dBA for more than 3 hours is approximately 930 square miles. About 190 square miles are above 29 dBA for 6 or more hours.

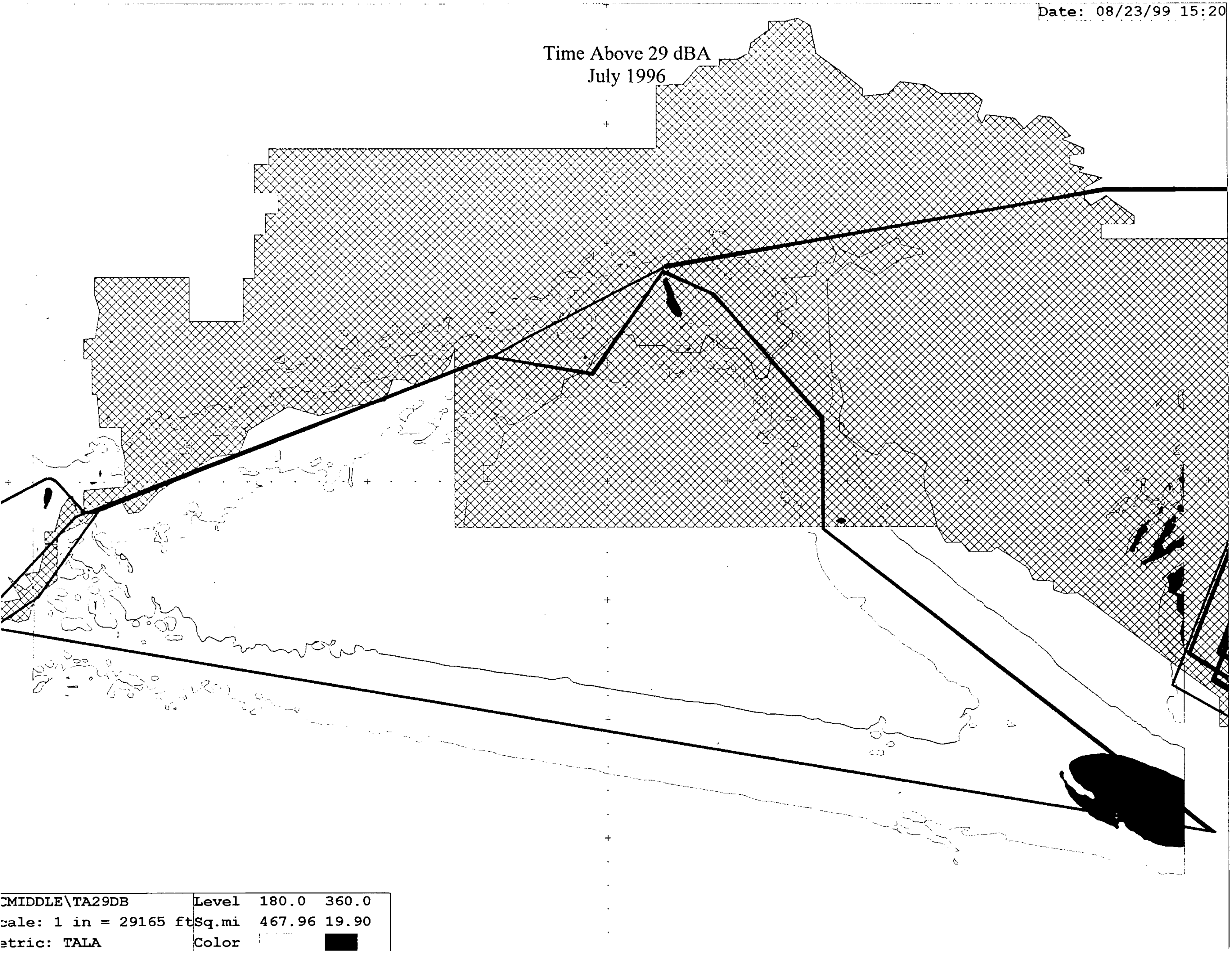
Of the 930 square miles that receive 3 or more hours of 29 dBA+ exposure only about 400 square miles is actually in GCNP[1]. About 110 square miles of the park are above 29 dBA for 6 or more hours.

The above numbers are based on an average day of operation. A weekday may have less flights while a weekend may have more.

Flights numbers have also increased somewhat since 1996 which may lead to more air tour noise in the canyon.

[1] The GCNP boundary near the Havasupai Indian Reservation varies from map to map. For conservatism, we have assumed that a large portion of this area is within the park boundaries. If it is not within the park boundary, the amount of the park above 29 dBA would be less than calculated above.


Date: 08/23/99 14:59
Time Above 29 dBA
July 1996
RANDCAN\TA29DB
cale: 1 in = 29165 ft
etric: TALA
evel 180.0 360.0
Sq.mi 409.39 99.23
Color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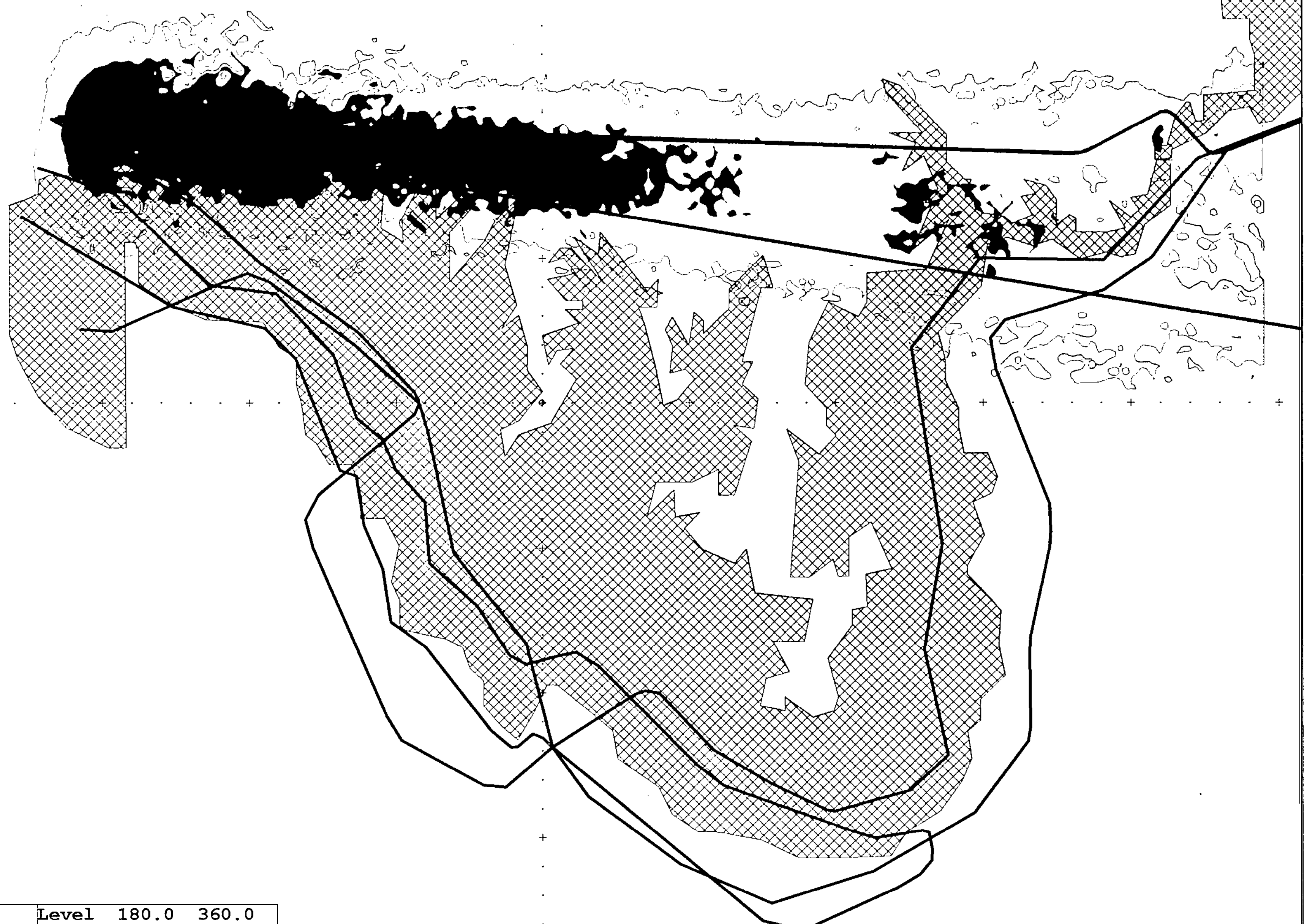
Time Above 29 dBA
July 1996
CMIDDLE\TA29DB
cale: 1 in = 29165 ft
etric: TALA
Level 180.0 360.0
Sq.mi 467.96 19.90
Color

Date: 08/23/99 15:11

Time Above 29 dBA
July 1996



CWEST\TA29DB	Level	180.0	360.0
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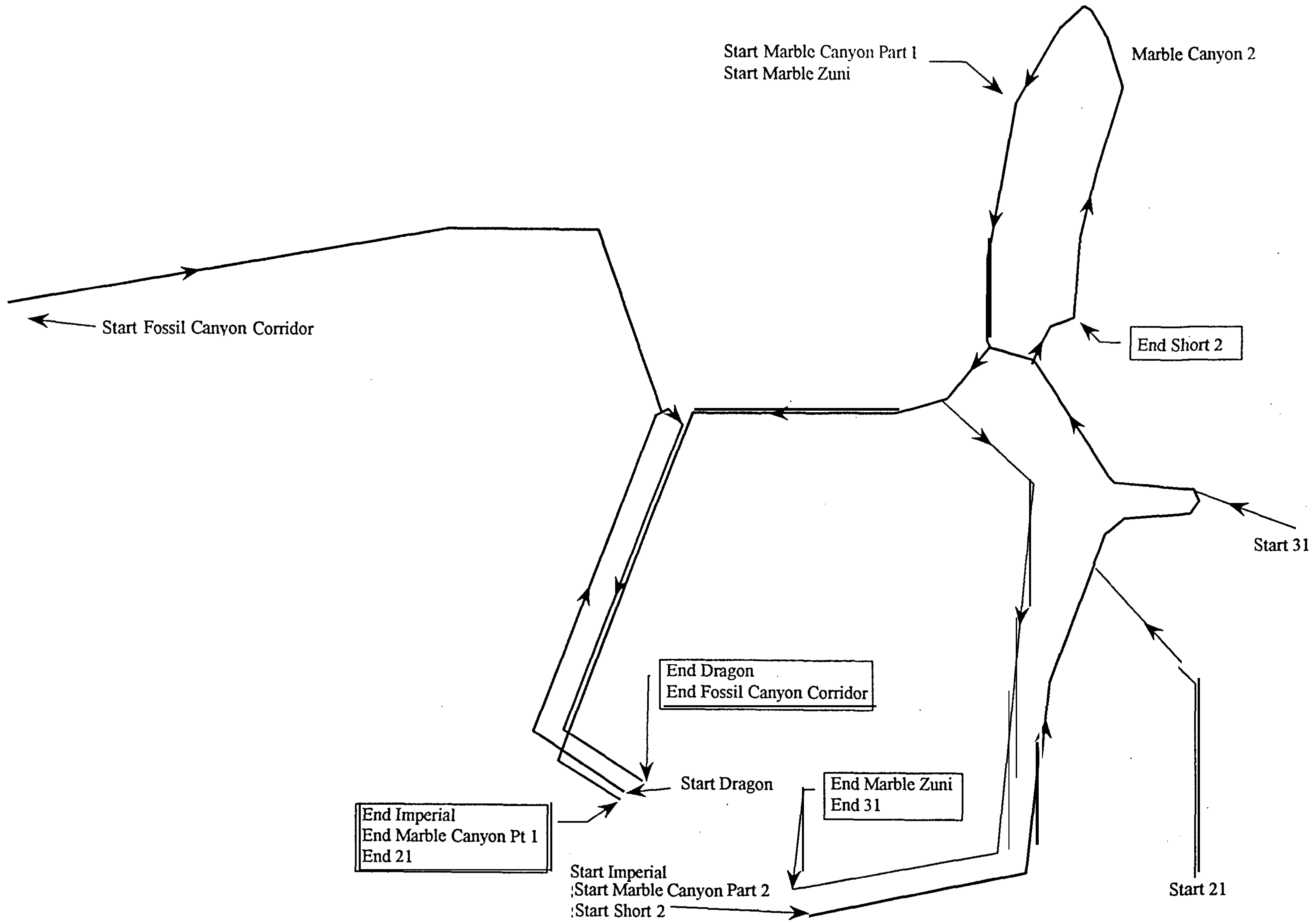
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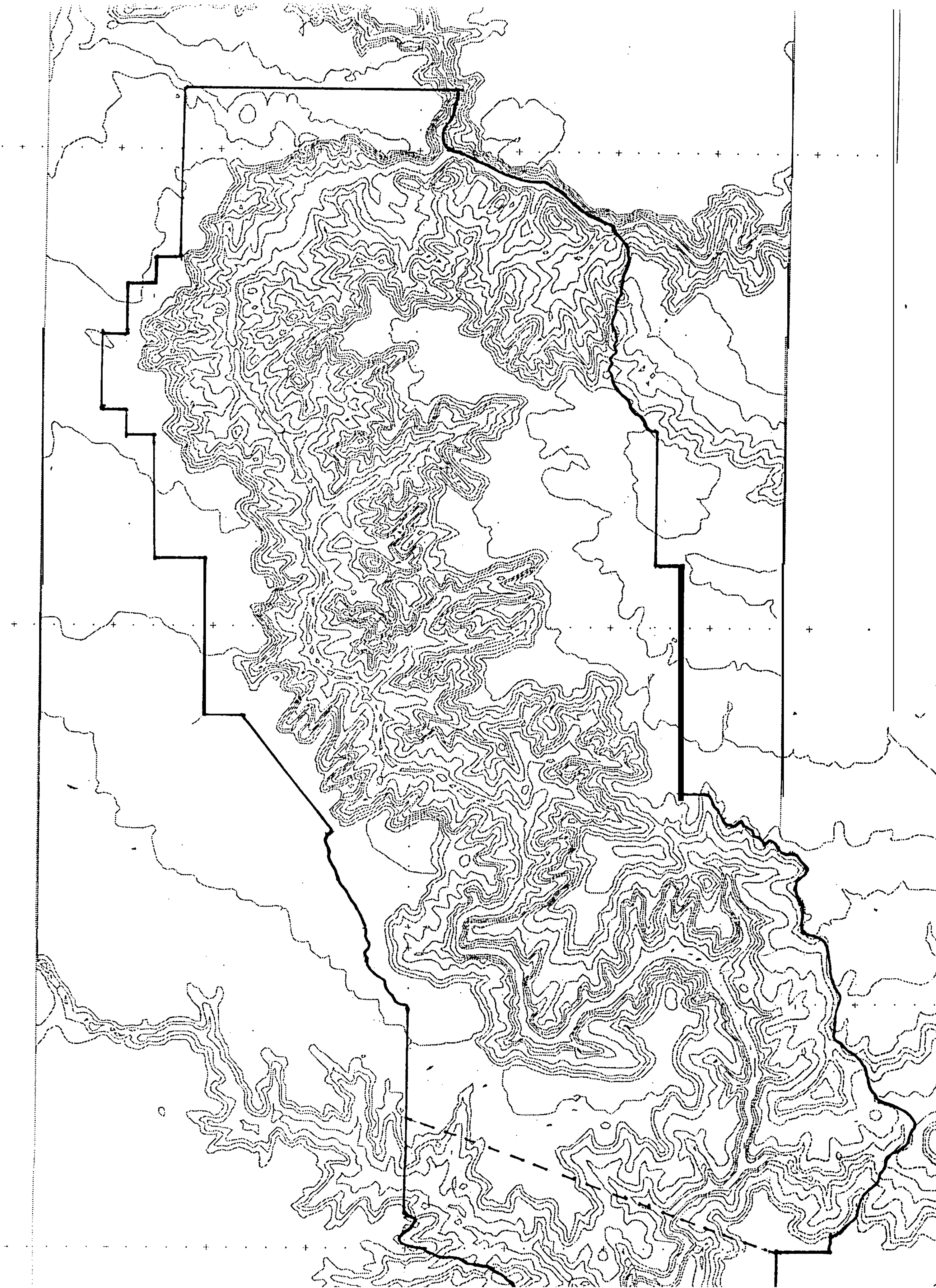

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An Analysis of Proposed Flight Restrictions at the Grand Canyon National Park: Estimating the Costs, Benefits, and Industry Impact of the Proposed Regulation

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August 18, 1999

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Executive Summarv

This study assesses the draft regulatory evaluation presented in the FAA's Initial Regulatory Evaluation and Regulatory Flexibility Analysis (RFA) of the Notice of Proposed Rulemaking for commercial air tour limitation in the Grand Canyon National Park special flight rules area. Special attention is paid to the cost-benefit analysis contained in the RFA, long-run economic impacts resulting from the proposed ruling, and the credibility of the analysis and methods contained in the report.

We find that the cost-benefit analysis is lacking in methodological rigor, the data used and the scope of the analysis. With respect to net benefits of the proposed regulation, the most glaring omission from the report is the failure to account for losses in benefits to air tour customers due to suggested fare increases resulting from restrictions on the number of flights. Also, a combination of suspect studies and conjecture is used to estimate the economic damages incurred by ground visitors to the Grand Canyon. Under different and equally reasonable sets of assumptions. the estimated IO-year benefits of the noise-reduction program are reduced by half to less than $ 17 million. The cost estimates also suffer from equally unfounded assumptions. Demand projections of the air tour industry, perhaps the most critical aspect of costs, are based on data that encompass all tower operations from the five airports that serve air tour operators, including commercial point to point flights and general aviation.

There are also problems with the base year chosen for the allocations, May 1997 to April 1998. The year is not representative of the long-run industry demand due to the large drop in Asian tourism during that time. In addition. weather conditions during the base-year precluded air operations for 45 days. These were the worst weather conditions in the history of Grand Canyon air tour operations. Evidence suggests that demand during that period was between 15 and 22% below long-run expected demand. Limiting flights to those flown in an unusually poor year puts all operators at risk of not being able to meet their capital obligations. There is the potential for many firms to fail, leaving the market to only a few firms. This possibility is not considered in any detail in the report. Costs of altering the fleet to a more competitive mix under the regulations are also not considered. All in all, the base year assumption and the failure to consider important economic impacts places the industry on a permanent recession footing.

Another problem with the proposed regulations is that they alter the long-run investment decisions of the air tour companies in a manner that is inconsistent with reducing noise levels in the Canyon. Since the allocations are not protected as a property right, the proposed rules induce a high degree of uncertainty into the future of the industry, which in mm distorts investment decisions of the firm operators concerning long-term investments, thereby raising capital costs. In particular, because the proposal does not include any incentive for acquiring quiet technology aircraft, higher capital costs associated with the uncertainty have the adverse impact of deterring investment in quiet aircraft.

Finally, the proposed regulations don’t consider any truly different alternatives to flight quotas. Quotas are inherently inefficient in the long run when attempting to control environmental problems. Incentive-based strategies are preferred to quota systems because they almost always offer the same level of benefits at a reduced cost. Under incentive systems for managing environmental problems, industries have a constant incentive to reduce the amount of noise through technological changes and innovations in an effort to capture the cost savings from reducing noise. Regulatory strategies based on incentives rather than quotas must be included in any final analysis.

I. Overview of the proposed regulations

The proposed rulemaking is a response to statutory mandate following from Public Law 100-91 requiring "substantial restoration of natural quiet to the Grand Canyon". The purpose of regulations is to restore natural quiet to the Grand Canyon National Park (GCNP). Natural quiet is defined as 50% of the Park experiencing no audible aircraft for 75-100% of the day. The focal point of the proposed regulations is a limitation on, and subsequent allocation of, commercial air tours to the Grand Canyon and establishment of new sightseeing flight paths. Specifically, the regulation modifies the dimensions of the GCNP Special Flight Rules Area by establishing new and modified flight free zones, adding curfews in some flight corridors, and raising minimum altitudes. Further noise reduction is achieved by limiting the number of sightseeing flights to the GCNP to 88,000 by proportionate allocation of reported flights to air tour companies operating during the base-year of May 1997 to April 1998.

Under the proposed regulation, flights will be allocated to companies based on their number of flights in the base year. Four types of allocations exist:

a. Peak season Dragon/Zuni flights

b. Peak season other area flights

c. Off-peak Dragon/Zuni flights

d. Off peak other area flights

Companies will receive one allocation for each flight they reported during the base year. Allocations will be adjusted for mergers and acquisitions occurring between the base year and the present. For example, if Company 1 flew 172 type a. flights during the base year, they will receive 172 allocations for that type each year for the next two years. Allocations are not a property right, and cannot be permanently transferred without the approval of the FAA. However, allocations may be transferred between companies (but not between types) on a temporary basis.

Federal laws mandate that when a significant number of small entities is impacted that the agency (the FAA in this case) must prepare a regulatory flexibility analysis (RFA). The law requires agencies to evaluate flexible regulatory proposals and explain the rational for their proposals. Prior to the Notice of Proposed Rulemaking (NPRM), an RFA was prepared to investigate regulatory alternatives to restore natural quiet in the Grand Canyon. It is to these two documents, the NPRM and the RFA, that the following discussion refers.

II. Calculation of Benefits

Reported benefits of the proposed regulation accrue only to ground GCNP visitors. Benefits to individual park users are estimated using a standard economic measure termed “consumer surplus” defined as the difference between what a person is willing to pay for a good and what they actually pay for the good (Zerbe & Dively, 1994). Total benefits are calculated using what the report terms “the benefit transfer approach”. whereby data from similar sites are used to estimate consumer surplus in lieu of collecting site-specific data. Benefits are estimated for three groups: river-users, backpackers. and others, including sightseers, hikers. and campers. Visitor days for each group during 1997 are 99,137, 182,48 1 and 5,788,187, respectively, giving total visitation during that year of 6,069,805.

Calculation of the total economic benefit of the regulation, in terms of consumer surplus. proceeds in several steps.

1) Using three different external willingness to pay studies, visitor day values are multiplied by total visitation in each category and total annual willingness to pay for recreation in the Park, without the regulation, is calculated.

2) Using an external study that provides qualitative information concerning recreationists' exposure to aircraft noise in the Park, varying levels of benefit reduction are applied to each category of visitor depending on their exposure to aircraft noise. Due to the lack of information concerning actual reductions in willingness to pay for recreation in the Park, benefit reduction is chosen arbitrarily as follows: 20% for those slightly impacted, 40% for those moderately impacted, 60% for those impacted very much, and 80% for those extremely impacted. A sensitivity analysis is reported that uses ½ of the benefit-reduction levels. The estimated total lost consumer surplus from aircraft noise for 1997 using the full-benefit reduction is $34,453,000.

3) Next, a linearized noise measure is calculated for the base year. Expected noise measures are calculated given that no action is taken to limit aircraft in the Canyon. For a given year. the percentage change between noise levels in the base year is applied to the lost consumer surplus. For example, the base-year linearized noise measure is estimated to be 1219.23 and 1577.47 in 2000. This is a change of 22.71% in noise levels, so undiscounted costs are reduced by 34,453,000*.2271=$7.82

million, meaning that benefits attributable to the regulation in that year are $7.82 million.

Criticisms of the methodology.

The estimation of the benefits of the proposed restriction on commercial air tours in the Grand Canyon has a considerable number of methodological flaws. These flaws include the choice of valuation technique for the nonmarket benefits, unfounded assumptions concerning economic damages, and failure to account for benefits of an entire consumer group - the air tour consumers. Due to the nature of nonmarket valuation, the results are highly sensitive to the data and assumptions used, making methodological rigor of the utmost importance. Below, we discuss each error or omission in detail, and where appropriate, recalculate benefits based on alternative assumptions to that made in the analysis in question.

Choice of valuation technique and studv selection criteria

The "benefits transfer method" of valuing a nonmarket good - such as recreation in a national park - is subject to large amounts of error as a result of deviation of the good in question from those used in the related studies, compounding of error from the original studies, and differences in the data available from the related study and that needed for the research at hand. Due to its inaccuracy, the benefits transfer method is not mentioned as a reliable valuation method in standard environmental economics texts such as Freeman (1993). If the criteria listed on page 43 of the RFA are indeed met, then the results serve only as a rough estimate of the site-specific recreational value and should not be taken as being consistent with the industry standard for nonmarket valuation.

Four valuation techniques are currently recognized as “state of the art” for estimating the economic value of nonmarket goods (Freeman, 1993). These are contingent valuation, hedonic studies, travel cost studies, and meta-analysis. Of these four, meta-analysis most closely approximates the benefits transfer method. With meta-analysis, the value of a nonmarket good is estimated using a set of past studies that value similar goods. A set of studies is used because the estimate, essentially an average of the values contained in the previous studies, is more precise than if only one study is used. Generally speaking, the precision increases as more studies are used.

Ironically, the meta-analysis approach has come under heavy fire from both economists and statisticians with critics claiming that the results are subject to large amounts of error due to small sample sizes. The benefits transfer method then, can be seen as the worst case of a highly suspect methodology.

The criteria outlined on pg. 43 of the RFA provide a basis for the selection of studies that should be included in a meta-analysis. Unfortunately, the study selection criterion, “selected economic studies must use appropriate valuation methodologies” is not adequately met for the HBRS, Inc and Harris, Miller, Miller, & Hanson, Inc. (1993) study (pg. 43 RFA). The study reports the percentage of visitors by category that are impacted either “not at all”, “slightly”, “moderately”, “very much”, or “extremely”. Ordinal categorizations such as this are absolutely useless for valuing the impact of the noise. A simple example illustrates this point. One person may respond that they were only slightly affected by the noise, but if questioned further, may be willing to pay $20 for the experience without noise. Another individual may be disturbed “extremely” by the noise, but only willing to pay $5 for relief. Therefore, the data neither economic damages from overflights or can any economic benefits of noise reduction be deduced from it. The estimated damages are entirely determined by the values chosen by the report authors for the benefit reductions assigned to each of the impact categories.

In essence, the report uses a poorly designed study (HBRS) in a suspect methodology (benefits transfer) and formulates conclusions that are not based on standard methods. The results concerning baseline losses in consumer surplus from aircraft noise, therefore, are untenable and cannot stand the test of scientific assessment. To illustrate this shortcoming, let's assume that the visitor-day value for those affected slightly is reduced by 1%, those affected moderately by 3%, those affected very much by 8%, and those affected extremely by 10%. Then the reduction in consumer surplus attributable to aircraft noise in 1997 is reduced by almost ten times from $34.6 million to S3.6 million. It is important to note here that no empirical evidence exists allowing us to choose bet\-veen these two estimates of S34.6 million and S3.6 million. In short, pure conjecture unsupported by any theory or evidence provides no basis for reputable rulemaking.

Assumptions concerning economic damages from noise

Further problems exist in the study concerning the benefits to Grand Canyon visitors from reducing aircraft noise. The calculations assume that the percentage reductions in noise result in a one to one percentage increases in benefits to the affected parties. Empirically, there is no reason to believe this, and indeed, economic theory posits the concept of diminishing marginal benefit, that is, additional units of a good provide less and less satisfaction for the individual. Typically, environmental damages are very low or zero at low levels of an externality due to the environment's assimilative capacity. As the level of damage. noise in this case, increases, economic costs increase to reflect higher damages from each additional decibel. In the framework of willingness to pay, the concept of increasing marginal cost of noise (or diminishing marginal benefit of quiet) means reducing the first unit of noise will have the greatest benefit to the individual, and the added benefit from each consecutive unit of noise will be smaller.

As before, we change the assumptions of the model and recalculate the benefits assuming that the first 6% of noise reduction increases benefits by 10%, the next 6.4% of noise reduction increases benefits by 8%, the next 6.8% of noise reduction is paired with a benefit increase of 5%, and the final 7% of noise reduction increases benefits by 1%. Using these assumptions, year 2000 benefits fall from S7.82 million in the FAA model to S3.7 million in our model. Again, we find large variations in program benefits resulting from changes in model assumptions. Accurate estimation of the consumer surplus of each activity and the noise damage function is needed in lieu of arbitrary assumptions about these critical parameters outlined in the report.

<u>Benefit losses to air tour consumers</u>

Probably the most glaring omission from the report is the failure to account for consumer surplus losses due to fare increases resulting from restrictions on the number of flights. The report concedes that as demand for flights increases, the airlines will be able to raise prices to recoup the lost revenues associated with more flights. If this is true, then for each dollar increase in the flight, each passenger loses a dollar in consumer surplus.

In a properly conducted cost- benefit analysis. this loss in consumer surplus should be subtracted from the consumer surplus for air tour passengers estimated for those visiting the Grand Canyon on the ground. There is no methodological reason for excluding the air passengers from the analysis, in fact. standard industry analysis of the impacts from regulation include estimation of the increase in costs to a firm and the lost consumer surplus to consumers in the industry.

Many substitutes exist for Grand Canyon flights. These substitutes include flights to other sightseeing destinations, travel by bus or car to the Canyon, or visiting another site altogether, then consistent with economic theory, we expect elasticity of demand to be higher than for leisure travel in general. Estimates of the elasticity of demand for leisure travel indicate that the value is approximately 2 (Shaw, 1988). Using a constant elasticity of demand estimate of 2 and an illustrative flight cost of $100, estimated losses in consumer surplus exceed $18.4 million for the ten years investigated in the report if the industry would have grown at 3.3% per year absent the regulation.

The report may also be criticized in how it presents other studies to support its findings. For example, though not offering any specific values, the report alludes to nonuse benefits that may accrue to the general public from Grand Canyon quiet. Specifically, the report refers to a study done for the Bureau of Reclamation concerning the non-use value of changes in flow levels in the Grand Canyon and makes the claim that the study provides evidence of "potentially significant non-use benefits from noise reduction in the Grand Canyon". One of the primary motivations of changing flow levels in the Canyon was to aid several species of native endangered fish. Endangered species derive their economic value from their contribution to biodiversity and are typically associated with high non-use values. Therefore, the high non-use value of changing dam operations is most likely associated with the endangered species that would be affected, and not any inherent value of returning the Grand Canyon to a "natural state".

Another example of misrepresentation is the report's claim that a discount rate of 3% is supported by economic theory. In fact, their chosen rate for discounting consumer surplus is not supported by economic justification. Though Freeman (1993) is cited, Freeman's actual discussion concerning choice of discount rates states that discount rates should reflect the opportunity costs of funds. However, numerous factors such as taxes, inflation, and some aggregation of the individual's rate of time preference, preclude a definitive answer on the choice of the discount rate. Choosing a rate that reflects the actual cost of borrowing for consumers is one practical solution. The chosen rate of 3 % is not a function of these variables and instead, seems to be chosen arbitrarily.

III. Calculation of Costs

Typically, calculating the costs of a regulation involves estimating the difference in net operating revenue with and without the regulation. The report does this in a detailed fashion, using variable costs by aircraft published in Economic Values for Evaluation of Federal Aviation Administration Investment and Regulatory Programs, including fuel. oil, maintenance, and labor as variable operating costs. Future industry demand is estimated using tower operations for the five airports associated with Grand Canyon air tours and published fares are used to estimate prices over the ten years under study. The number of passengers under the proposed regulation assumes planes will fly at full capacity, given adjustments for seasonal load factors.

Criticisms of methodology.

Examination of the cost analysis and the underlying assumptions reveals several potential problems with the assumptions, analysis, and findings. These include assumptions concerning firm revenues, growth rates, the choice of the base year as an accurate assessment of current industry equilibrium, and the impact on the firms of increased capital and transaction costs. Each of these points is discussed in turn.

Calculating baseline prices

When calculating baseline prices for estimating baseline revenues, “published prices” were used. However, as conceded in the report, the bulk of the passengers are booked either through the casinos or through tour agencies, and bulk discounts often apply, implying total industry revenues may be lower than those reported in the document.

Another potential problem with the tour prices used in the report is that they reflect current unregulated routes. Proposed changes in the flight paths requiring higher minimum altitudes and limited viewing of certain areas of the Canyon could impact customers’ willingness to pay for flights if the length of viewing time or aesthetic experience is diminished. This possibility, and any probable adjustment in prices, is not included in the analysis.

Forecasting industry growth rates

A shortcoming in the cost analysis involves the estimation of air tour industry growth rates. The industry growth rates (absent the regulation) assumed in the report appear to be based on operations of all commercial and general aviation flights using the five airports used by Grand Canyon air tour operators. There is no reason to believe that the air tour industry will grow at the same rate as other air travel at the airports. In fact, general aviation and business-travel would be expected to grow with total employment and population, while leisure-travel growth is most likely to follow growth in hotels, casinos, and other attractions. Moreover. the most critical component of demand for the air tour market is foreign travel. The recent Asian crisis resulted in significantly different growth rates between commercial point to point, general aviation, and the Grand Canyon operators. Therefore, use of aggregate growth rates is likely to bias estimates of growth in the air tour industry alone. The direction of bias may not be determined without statistical and economic modeling directed at the commercial air tour industry instead of the transportation airline and general aviation industries.

Choice of base year

Perhaps the most problematic assumption in the analysis is that the base year chosen is an accurate picture of air tour industry demand. In fact, the year is not representative of long-run industry equilibrium either presently or historically. The collapse of several Asian currencies in the third quarter of 1997 had an enormous impact on Asian visitation to Las Vegas and other American cities, with Asian tourism into Las Vegas declining by 24.3 percent according to the Las Vegas Convention and Visitors Authority.

A survey of Southern Nevada-based air tour passengers done by the Center for Business and Economic Research at UNLV indicates that in recent years, over 90% of clients for the Southern Nevada based operators are international visitors. See Table 1. According to the *RFA*, Asian visitors have historically accounted for 60 to 90% of the demand for air tours to the Canyon. If 60 to 90% of the customer base is reduced by 24.3%, then this can translate into a demand shock of 15 to 22%. See Table 2. The consensus among economists is that the economic impact of the Asian Crisis, while temporarily undermining Asian service exports such as commercial air tours. is a temporary phenomenon and not a long-run feature of international trade. Given the financial assistance granted by the International Monetary Fund to Korea and Japan's current stimulus package, the Asian economies are expected to resume economic growth this year. implying a return to more favorable conditions.

Table 1. Flights, passengers, and origin of passengers from a survey of Southern Nevada Grand Canyon air tour operators

	1995	1996
Number of flights	37,649	60,029
Number of passengers	369,205	436,925
American	30,831	35,051
Foreign	338,374	401,874
Percent American	8.4	8.0
Percent foreign	91.6	92.0

Table 2. Asian visitation to Las Vegas, 1997 and 1998
Source: Las Vegas Visitors Convention Authority

	1997	1998	% change
Japan	403,000	342,000	-15.1
S. Korea	122,000	61,000	-50.0
Singapore	26.000	14,000	-46.2
Taiwan	79,000	60,000	-24.1
Total	630,000	477,000	-24.3

It is important to note that the rapid devaluation of Asian currencies was a completely unexpected event, both from the position of international currency traders and air tour industry forecasters. As such, the subsequent fall in demand for Grand Canyon air tours was also unexpected and unforecastable. Since capital investment decisions are based on expected demand, using a historically low year for allocations endangers the operator's ability to cover capital costs. The regulations would force firms to produce at a level well below their capacity. Failure to cover long-run capital and other fixed costs will eventually lead to firm closure and increased industry concentration.

Capital and transaction costs

Air tour operators chose airplanes by weighing the operational costs of the aircraft. seating capacity, and viewing experience. Larger aircraft may have lower average operating costs, but don't provide the same viewing experience as smaller aircraft. Since airplanes have a 20-year usable life, the number of aircraft purchased by the firm is a long-run decision that is based on long-run demand for air tours. Flight restrictions, especially those based on deviations from long-run demand, will alter the size and number of aircraft that enable firms to be efficient, forcing firms to alter their fleet in an attempt to remain competitive. These costs are not included in the report.

Changing their fleet will incur two costs to the firms that are not included in the report. Transaction costs, those costs incurred by selling old aircraft or purchasing new ones, will be substantial for firms that have fleets of smaller aircraft. Net capital costs, the per passenger difference between the cost of the old airplane and its replacement, will also be high for those firms that must alter their fleet to remain competitive. Neither of these costs is included in the report.

IV. General Criticisms of the regulation from an efficiency perspective

The preceding sections have focused on the failures of the cost-benefit analysis contained in the RFA. Though benefit-cost analysis, when done correctly, may successfully assist policymakers in ranking alternatives, it provides little insight into the relative efficiency of alternatives that are not discussed. Further, long-run economic impacts are generally not accounted for in a cost-benefit analysis. The following paragraphs discuss the long-run economic implications of the proposed rulemaking, and the shortcomings of the FAA analysis with respect to long-run substitution effects among ground and air visitors to the Canyon.

<u>Firm exit. industry concentration. and consumer welfare</u>

The report does not analyze air tour industry impacts in terms of firm failure and downsizing in any meaningful fashion. To be sure, the report admits that since some operators were operating at a loss during the base year, that these firms and others may be put out of business. Given the meager amount of data used in the analysis, however, one cannot test the hypothesis of profitability or viability. A clear picture of the industry after hvo years of regulation is conspicuously absent from the report.

As operating costs rise from new reporting requirements and increased fuel and labor costs associated with new flight paths, it is highly probable that some firms will not be able to cover overhead costs and will be forced to exit the industry. This will have two negative social impacts. First, the industry will become more concentrated, inducing losses in consumer surplus as prices rise. Second, firm closures will result in unemployment of ground and flight crews for the affected firms.

Though short-run production decisions are correctly based on short-run profits (total revenue less total variable cost), the decision of whether to continue to produce or exit the industry is based on long-run economic profits (expected future revenues net of total operating and fixed costs). The regulatory cost analysis focused on the variable costs, due to the availability of data. To understand the long-run impacts to the industry as a whole, such as industry concentration, firm revenues, and economic profit, one must look to fixed costs. As one might expect, the fixed costs borne by air tour operators are substantial. According to Schwer et al. (1999), fixed costs, including insurance. aircraft, facilities rental. and other leases are 19% of the total air tour industry expenditures for Southern Nevada.

The report acknowledges that of the six operators for which they have profit data. hvo suffered financial losses during the base year. However, the report fails to discuss this topic in a quantitative fashion. If firms are restricted to output levels that caused them to suffer losses, their future viability is in doubt. It may be unreasonable to extrapolate from the sample and suggest that 1/3 of the firms will go out of business due to the proposed rule, especially since there is a strong indication that the mandates will cause firm failures.

Though the report recognizes that firms will fail as a result of the regulation, they don't allow for the possibility that the eventual outcome may be only a handful of firms supplying the entire market. In the extreme, the regulation could create a monopoly, or eradicate the industry altogether.

These adverse possibilities are given short thrift in the report. Market concentration is associated with higher prices and restricted output if firms gain market power through increased market share. Though higher prices and restricted output may seem to naturally benefit those seeking quiet, they result in another round of losses to consumers of air tours, and the net benefit may be negative. Firm downsizing means unemployment for redundant employees. If all firms fail, the collapse of the industry will mean large losses in consumer welfare, as well as unemployment and associated social problems.

In summary, the final result cannot be determined without further investigation into the elasticity of demand for commercial air tours and a reasonable forecast of industry size in the future, given that some firms leave the industry. The study is clearly incomplete concerning this very important issue.

Adverse impacts from noise reoulation

Another problem with the proposed regulations is that they alter the long-run investment decisions of the air tour companies in a manner that is inconsistent with reducing noise levels in the Canyon. Since the allocations are not protected as a property right, the proposed rules induce a high degree of uncertainty into the future of the industry, which in turn distorts investment decisions of the firm operators concerning capital and other long-term investments and raises capital costs. In particular, because the proposal does not include any incentive for acquiring quiet technology aircraft, higher capital costs associated with the uncertainty have the adverse impact of deterring investment in quiet aircraft. Quiet aircraft could provide a permanent solution to the noise externality while still allowing the air tour industry to grow at a modest pace.

Substitution effects. environmental degradation. and social efficiency

A major shortcoming of the study is its failure to account for substitution effects between those tourists visiting the Canyon by air and those tourists visiting using ground transportation. Clearly, some of those deterred by rising prices for air tours will opt to visit the Canyon by ground. According to a survey of air tour passengers for tours originating in Southern Nevada done by the Center for Business and Economic Research at UNLV, 27% of air tour consumers stated that they would still consider visiting the Grand Canyon if air tours where eliminated. Using the 3.3% expected growth in the air tour industry projected in the *RFA*, the regulations will turn away 230,146 air visitors between 2000 and 2010, resulting in increased demand for ground visitation of 62.139.

Ground visitors impact air quality, strain camping, service and waste disposal resources in the Park, and contribute to the already congested environment. These impacts should be considered in the rulemaking.

Foreign trade impacts of the oroooosed regulation

The report acknowledges that due to the high percentage of foreign patronage of Grand Canyon air tour services, foreign trade may be affected by disruption of marketing of the tours. A survey of Southern Nevada based air tour passengers done by the Center for Business and Economic Research at UNLV indicates that in recent years. over 90% of clients are international visitors. See Table 1.

Though this is a possible source of declining demand, the more likely foreign trade impact is the loss in service exports of flights that would be demanded but cannot be sold due to the regulation. This is not considered at all in the report.

V. *Alternatives to the proposed regulation*

The Regulatory Flexibility Act and the Small Business Act require regulators to consider alternatives to the proposed regulation when a significant number of small entities are affected by the regulation. The proposed regulation is in essence, a quota on the number of flights that may be flown to the Grand Canyon. The two alternatives listed, allowing for a three month peak season or allowing for permits to be used any time of the year, though offering some variation in policy, are not the most economically based alternatives to the regulation. An entire class of alternatives – incentive based systems for moving to quite technology aircraft -has been completely ignored in the document. This is a distressing oversight.

For example, the report does not consider in any detail economically more efficient alternatives to the proposed quota system providing subsidies to the air tour operators to encourage a switch to noise efficient aircraft. A subsidy would provide incentives to replace older, noisier aircraft with more noise efficient aircraft while reducing losses to consumer surplus for both air and ground visitors to the Canyon in the long-run. The thinking is to allow air tour operators the latitude to determine the least cost method to reduce noise, instead of having a central authority, unfamiliar with their industry, make that determination.

Amongst economists, incentive-based strategies are preferred to quota systems like the one proposed for the GCNP because incentive-based strategies almost always offer *the same level of benefits at a reduced* cost (Field, 1997). This is because quota systems are an all or nothing proposition – overflights and noise are reduced one time, and benefits stagnate. Under incentive systems for managing environmental problems, industries have a constant incentive to reduce the amount of noise through technological changes and innovations in an effort to capture the cost savings from reducing noise. Therefore, benefits of the program will increase over time, as the marginal costs of the program eventually decrease.

The failure to investigate the benefits and costs of an incentive-based program for reducing aircraft in the Grand Canyon is a major flaw in the proposed rulemaking. Given that the same benefits could be achieved at a lower cost to producers, the omission restricts policymakers to consideration of a few very similar and inefficient methods for reducing aircraft in the Grand Canyon is a major flaw in the proposed rulemaking. Given that the same benefits could be achieved at a lower cost to producers, the omission restricts policymakers to consideration of a few very similar and inefficient methods for addressing the issue.

VI. *Suggestions for re-evaluation of the costs and benefits*

The final results concerning the level of benefit from the program are highly sensitive to the methodology used. and as such, the benefits attributed to the pro-gram are highly suspect. Though many noneconomists are unfamiliar with the standard methods for nonmarker valuation, a consensus has been reached in the economic research community concerning the appropriate techniques for nonmarket valuation. These procedures were almost entirely disregarded in the analysis. The final results concerning the level of benefit from the program are highly sensitive to the methodology used. and as such, the benefits attributed to the program are highly suspect. Given the very large economic impact suffered by the air tour operators conceded by the report, a rigorous and scientifically based assessment of the economic benefits of the program should be performed to justify such large industry impacts. Therefore, we suggest a more appropriate approach to estimating economic benefits and costs that relies primarily on site-specific data and direct observation by people actually affected by the noise.

For assessing the economic benefit to people on the ground of the proposed regulation, the appropriate estimation technique is contingent valuation. Another method, the travel cost method, deduces an individual's willingness to pay for a visit to a site from the costs of their travel to the site, is inappropriate in this situation because visitors to the Canyon often visit other sites as part of their total trip. When this is the case, it is misleading to attribute the entire expense of the trip as willingness to pay for only one site.

In contingent valuation, visitors to the Canyon are questioned, either in person, my mail, or over the telephone, concerning the impact of aircraft noise on their visit. Specifically, various hypothetical scenarios are posed to each respondent involving varying levels of aircraft noise and their willingness to pay for a Grand Canyon trip, given that level of noise. Survey respondents are also questioned about their activities in the Canyon and other visitor-specific characteristics such as income that may affect their demand for Grand Canyon trips. Using the information obtained from the survey, a demand curve may be estimated and the loss in consumer welfare may be calculated.

Estimation of the costs of the proposed regulation must also be addressed before the study has any credibility. A demand curve may be estimated using industry data over time obtained from the air tour operators and consumer and producer surplus losses can be derived from that. However, given the variability of the demand for Grand Canyon air tours. caution must be taken when projecting demand for flights over the next ten years.

A credible forecast model will use industry-specific data in conjunction with national forecasts of international trade with respect to Asian countries, as well as growth in the Las Vegas hotel sector. Given a reasonable projection of growth in demand for Grand Canyon air tours, estimation of the consumer surplus loss to the consumers proceeds in a relatively straightforward fashion.

VII. Conclusion

The RFA contains serious methodological flaws that cast doubt on the results concerning the benefits and costs of the regulation. Suspect modeling techniques are used to calculate benefits to GCNP visitors. The lost benefits to an entire consumer group, Grand Canyon air tour customers, are not included in the analysis. With respect to costs, industry growth rates are based on inappropriate data, and almost certainly understate the long run growth rate. Also, the cost of altering the air tour fleet mix necessitated by the new regulation is not included.

The base-year chosen for the allocation was 15 to 22% below long-run expected demand for the industry. Therefore, the allocations force the operators into a period of permanent recession, which will lead to the closing of several firms, losses to consumers, and unemployment in the industry. Industry concentration is also a likely result.

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